Popular Mechanics

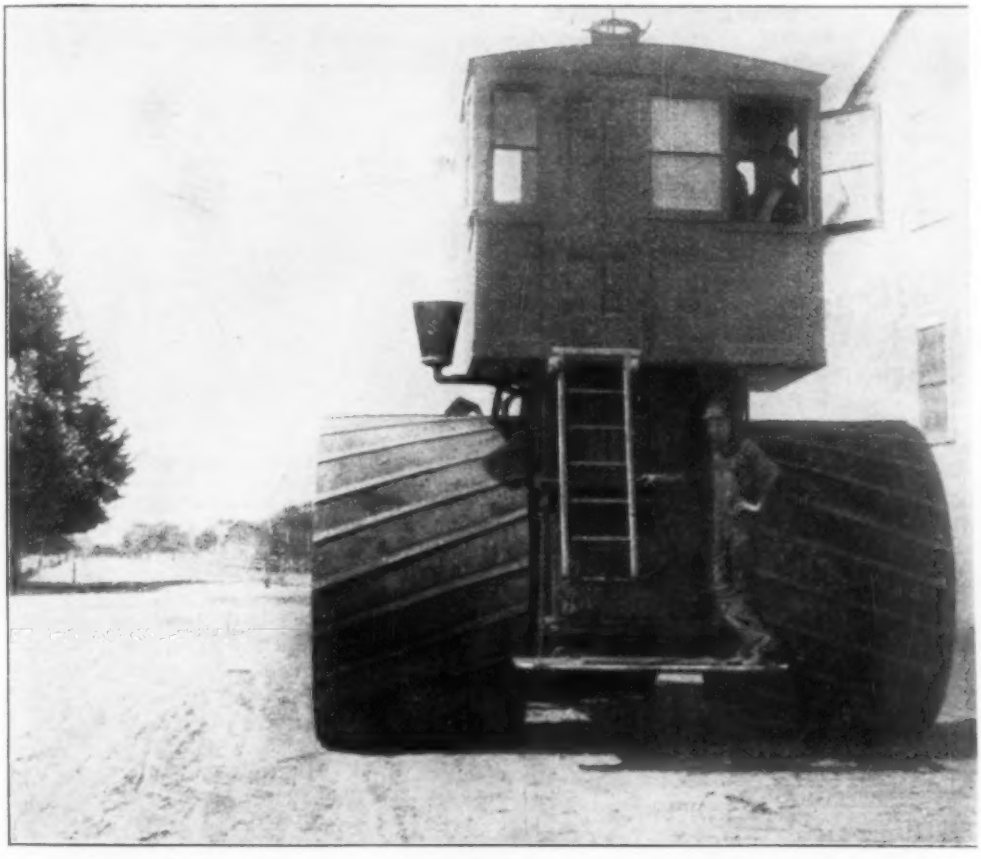
Vol. 5. No. 4. CHICAGO, DECEMBER, 1903. 10 Cents a copy. $1.00 a year.

Trackless Trains of the Twentieth Century

They Invade the Desert and the Wildwood and Bring From Remotest Regions Nature's Hidden Treasures to Enrich the World's Commerce

Trains that move along dirt roads, or roll over the desert's trackless sands, or in the forests, plowing their way through the underbrush as they pass; trains that ford streams and climb the mountains' sides where railroads never dared to go; trains that turn and stop when and where they please, with rights-of-way as wide as the fields and valleys, the woods and the hills, where they ramble at the will of the engineer. These are the trains hauled by the traction engine, the new, great iron-horse of the 20th century.

Largest Traction Engine in the World



125-Horsepower Traction Engine Made and Used in California

This iron horse has brought with it a

Traction Engine Hauling a House

new age of commerce. No longer does the mine with its rich deposits of ore lie idle because the railroad does not see fit to build to its site; no longer do the desert's treasures find seclusion in their fiery, desolate bed; fine woods of the remotest trees of the forest are now reached by the woodman's axe; lands far distant from the route of the regular freight and passenger train may now be tilled and made to contribute to the world's commerce; distant quarries are worked, and all sources of commerce are made less depeadent upon the railroad and steamship than ever before.

Many traction engines are in service in many capacities, and as their utility dawns more clearly into view, they are becoming more numerous and their field is widening many fold. There is now scarcely a commercial pursuit in which the traction engine does not figure. It is displacing the horse, the mule, the tram engine, and the lumberman's "dinkey." But while it makes the country's resources less dependent upon the railroads, still it increases the railroad's traffic. For the traction engine rides out into the hitherto unworked, unexplored regions and brings back to the railway station the products of the newly opened fields of commerce for the railroads to haul.

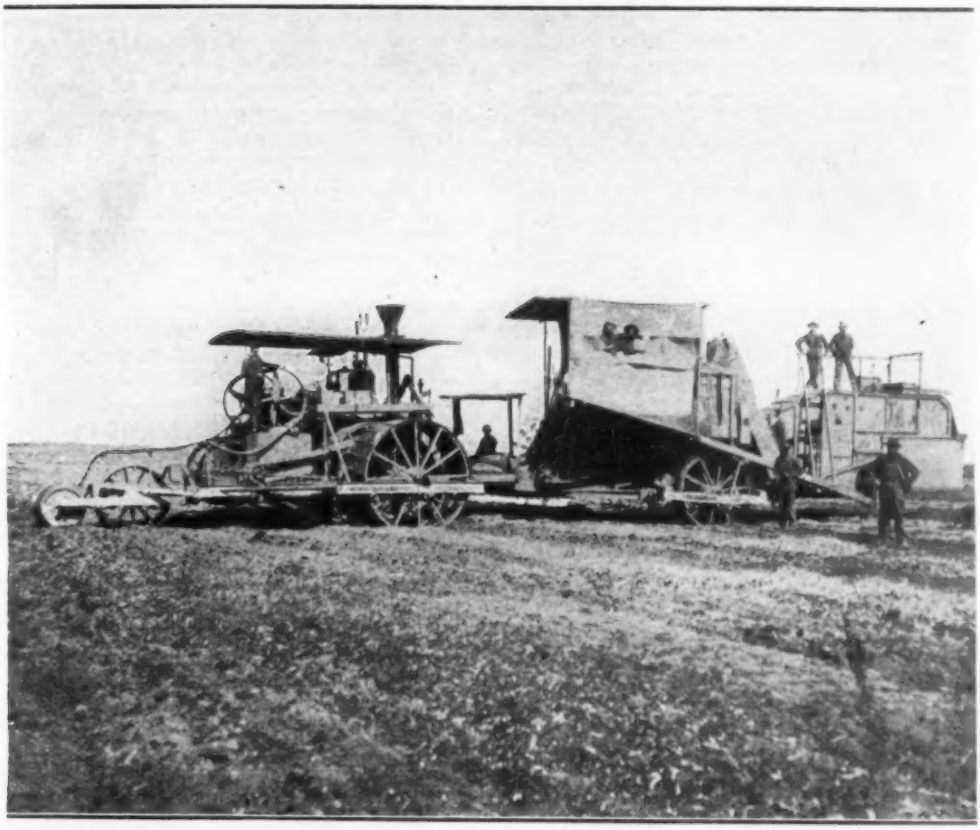
Great is the traction engine and each day it is becoming greater. While the world has been a long time inventing the perfected tractor, the machine has at last reached an advanced stage of commercial proficiency; while it is in use in hundreds of different pursuits, it is yet in its infancy. Popular Mechanics has called it the "automobile of the woods," it might be called the "automobile of the desert" or the "private freight train and railroad of the farmer and miner, and lumberman." Truly it is to the wood, and the mountains and all the great land of the wilds what the automobile is to the

Side View of the World's Largest Traction Engine

city, and more. As with the automobile, its path is not marked by parallel steel tracks; its right-of-way is not restricted; its movements are not governed by time schedules; it is not switched and side-tracked on a narrow railway by orders of a train dispatcher; it is not blocked by impediments in its track. Its patch is wide, its movements are free.

The automobile's principal employment is in pursuit of pleasure; the traction engine's is the development of the country's resources. The average automobile looks insignificant in comparison, for the traction engine is a gigantic, powerful machine that would ride over the

On the Way to Work



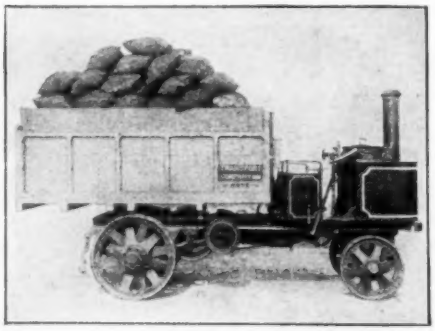
THE TRACTOR ON THE FARM is rapidly succeeding the farm horse and is causing a revolution in the manufacture of farm machinery. It was here that the powerful "railless locomotives" first demonstrated their wonderful usefulness and from the farm they have spread to the forests, the mountains, the desert and the mines of America, South America and South Africa.

Enterprise says: "The steam traction engine was primarily used in conjunction with steam harvesting and farming machinery and in that field of enterprise alone it finds a broad scope of manipulation, but it was laterly developed into the present broad massive and powerful road engine and employed in many different phases."

largest tourist's car and seem unaware of an impediment in its way.

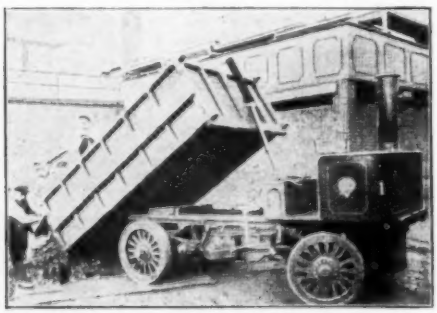
The greatest traction engine ever built is illustrated herewith. The progress in development is rapid though and it may not be long until even a greater is built. This particular tractor is the product of San Leandro, Cal., where traction engines for mining, lumbering, etc., are made. It is of 125 horse power, and can climb a grade of 25 per cent, carrying 20 tons. A tank on the engine holds 600 gallons of water, which will last the engine six miles. The same amount can be carried in the front part of the first wagon, making enough to go twelve miles without replenishing. As many tanks as desired can be added to the train, but of course, these diminish the capacity of the engine in proportion to their weight; so it is better when the water supply can be renewed every six or twelve miles. This engine is 17 ft. high, and 15 ft. wide from outer edge to outer edge of its enormous wheels. To illustrate the economy of the traction engine it has been proven that this ponderous machine costs but $18 a day for operation. Oil, coal or wood can be used for fuel, with equally good results, without altering the firebox. An oil burning attachement is furnished

when the liquid fuel is desired. Its manufacturer says: "The outfit or train requires an engineer and fireman; when freighting in a mountainous country, however, a



English Dumping Traction Engine, Loaded

third man may be required to attend brakes when descending steep grades, also to help load and unload the train. This type of engine is used in this state and throughout the coast for hauling logs, lumber and



English Dumping Traction Engine Unloading

other kinds of material, some of the large milling countries using as many as five or six of them each."

TRACTION ENGINE IN WAR.

"Fuhrcolonne, Motorfahrzeug und Feldbahn," says:

"An army which takes the field today requires an immense amount of food and rations. In order to facilitate the supply and transportation of the same, and to be in a position to utilize the large supplies of coal which the various industries of the Empire have stored up for their use, the road locomotive is destined to play a very important part in the future. In time of war railway lines as means of communication are often destroyed, thus rendering the establishment of new ones an absolute necessity. The road locomotive makes it possible within a very short time to completely change the base of supplies of an advancing army."

The road locomotive is used by the armies in Europe for a great many practical purposes. The transportation of heavy siege guns across country, the moving of the machinery balloon detachments and iron and steel targets from place to place, not to speak of their use as engines to drive dynamos, threshing machines, plows, etc., all show the many practical benefits of such locomotives.

In 1899, when the Boer war was well under way, the English government ordered a large number of traction engines from Germany. During the progress of the war the heavy guns of the English warships were often brought into use to support the regular field artillery. It was impossible to haul such guns across unbroken veldts with spans of oxen. The practicability of such locomotives to pioneers in a new country

Traction Engine Uprooting Trees

is apparent. In such countries as South Africa, Siberia, and the States on the lower Danube and in the agricultural districts of Prussia it is claimed that German firms are doing a good business in the sale of these machines. The engines are used on farms for pulling down trees and hauling heavy loads of lumber, as shown in the illustration. It may also be used to advantage in factory yards by attaching a crane.

IMITATION ASTRAKAN.

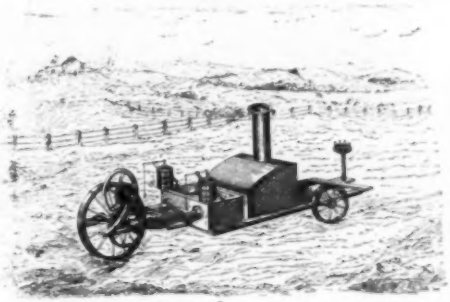
In order to impart to smooth or wavy haired skins the appearance of Persian or Astrakan skins, a German inventor proceeds by forming the hairs on the skins into bundles, to the ends of which he applies an adhesive substance, such as caoutchouc solution. The ends of the bundles are then drawn through the skin so as to form loops and are secured at the flesh side of the skin by an adhesive or by sewing.

Growth of Industrial Art

The Traction Engine

While the traction engine is generally regarded as a new invention the origin of engines built to run on the high roads date back more than a century. The first one recorded made its appearance near Redruth, Scotland, in 1786. Symington of Scotland and Oliver Evans of America, built models designed for the same purpose.

Boydell's traction engine had endless chains of boards fitted to its wheels, forming



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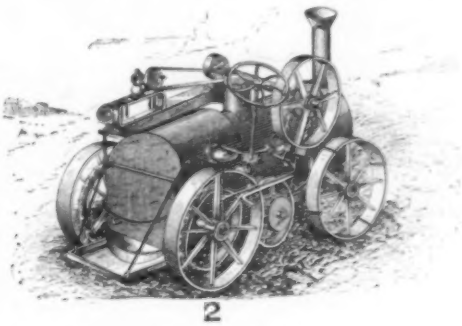

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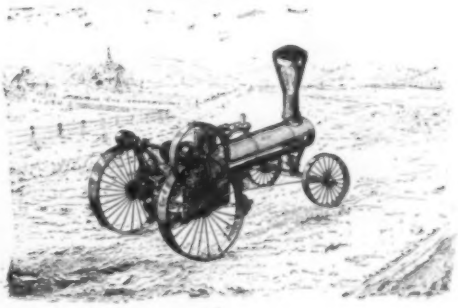

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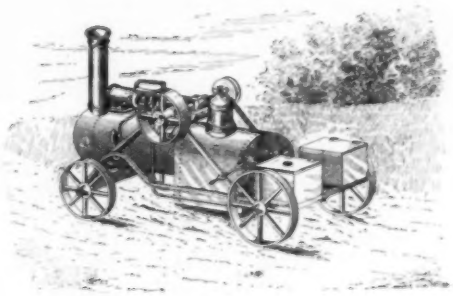

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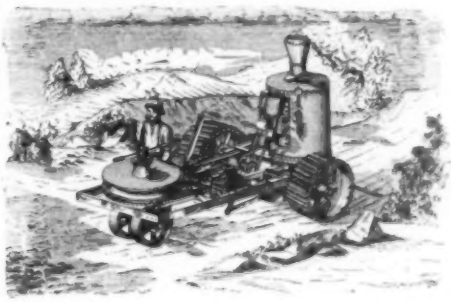

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No. 1—U. S. patent steam wagon—1817.
2—U. S. patent traction engine—1873.
3—U. S. patent power steering road engine—1881.
4—U. S. patent road and agricultural engine—1882.
No. 5—U. S. patent adjustable leveling road engine—1883.
6—U. S. patent winding drum and road engine—1884.

a sort of endless railway, which was laid down and taken up by the engine as it proceeded.

After this there was a dearth of interest in this type of engine for many years. The railroad began to score great success in all parts of civilization, and this fact, it was then considered, left no field for the tractor. In 1817 a new type of road engine appeared in the United States. It was called the steam wagon, and met with considerable success. Interest lagged again until 1856 when the subject was revived with a view to adapting such engines to agricultural purposes. All the early forms were called road engines or steam wagons. The first to be known as the traction engine made its appearance in 1873 in the United States. From this on the United States assumed the lead in the manufacture of this type of vehicle, though their early success was still restricted. In 1881 what was known as the "power steering road engine" was invented. Other types then followed in quick succession. There was the "road and agricultural engine," the "adjustable leveling road engine" and the "winding drum road engine."

It is only of late years, however, that the traction engine was built of sufficient strength and convenience to make it of commercial importance. There were many obstacles in the early types that later inventions have completely overcome and the new traction engine serves a purpose that no other machine could answer. The tractor has come to stay and its future development promises to be many times more rapid and substantial than ever before.

A traction engine for running on ice has been successfully employed in carrrying passengers between St. Petersburg and Cronstadt, Russia.

The latest and greatest traction engine is illustrated and described elsewhere in the preceding chapter.

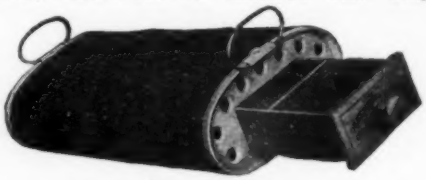
STEAM TURBINES REQUIRE FEW REPAIRS.

Another big advantage of the steam turbine over the reciprocating type has developed after a year's test in Switzerland. The turbine ran 7,000 hours with only 5½ hours spent in repairs during the entire time. Ninety-five gallons of oil were used in lubrication in 12 months.

Popular Mechanics want ads bring returns.

STOVE FOR AUTOMOBILISTS AND SLEIGH RIDERS.

No more cold feet while sleigh riding or in midwinter automobile tours. A portable stove that emits neither smoke, fire nor soot has been invented. Like a round elongated foot-rest the stove lies in the bed of the sleigh, automobile or carriage and keeps



Portable Stove

the feet as warm and comfortable as a steam heated flat. The stove is covered with cloth of the color of the sleigh, automobile or carriage lining. It burns a specially prepared flameless, smokeless, sootless, odorless coal.

SIGNAL SYSTEMS FOR HIGH SPEEDS.

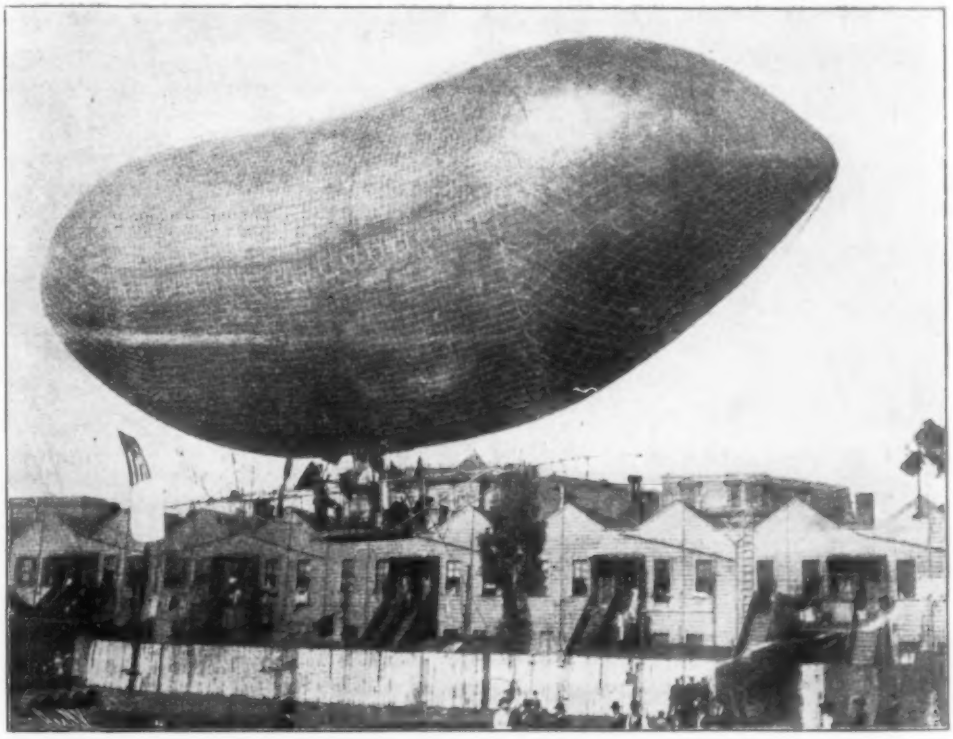
In the November issue of this magazine a description was given of the electric car which broke all records for high speed, by traveling at the rate of 130 miles an hour, or 191 feet per second. That we are soon to witness a revolution in the running time of passenger trains is generally conceded. The change, however, cannot be made until many essential details are worked out and brought up to conform. For instance the very important element of signals must be considered. Under present systems a signal set at 2,000 feet distant is considered sufficient for trains running at present speeds, but to allow for the same length of time in which to stop a train moving at 100 miles an hour, the signal would have to be set back from 4,000 to 7,500 feet. Present mechanical signals worked with wires are limited to about 2,000 feet. Electric signals of course could be worked at any desired distance. At a speed of 191 feet per second, an engineer would cover the 2,000 feet in a little over 10 seconds, which is obviously not sufficient to stop a train.

"Whether fighting or working, men are the same; they are assisted by good equipment, improved by good management, made more efficient by proper surroundings and comforts, and work more intelligently when properly trained. This is neither philanthropy nor socialism. It is business."

Airship Flies Over San Francisco

Device of a Poor Physician Performs a Wonderful Feat Witnessed by Thousands

A poor physician of the Pacific coast may have solved the problem of aerial navigation. Dr. August Greth recently sailed an immense airship over the city of San Francisco, guiding it in every direction, until the motor began to fail and it finally dropped into the bay. This was while sailing over toward Marin County. Thousands witnessed the performance in wonderment. The doctor says that he could have crossed the bay and that he let the machine down into the water purposely that it might be brought back by the life-saving station, thus saving him the expense, which would have amounted to considerable had he continued the trip across and landed on the Marin county shore. A life-saving crew of the Prosidio reservation picked up the aerial craft and brought it and the inventor safely to land.



Dr. August Greth's Airship Beginning its Ascension in its Remarkable Flight Over San Francisco

The airship made its ascent from Market and Eleventh streets. It rose steadily and majestically to a height of 2,000 feet. When the motor was started, the craft responded by descending several hundred feet and circling about the city after which it started out over the bay.

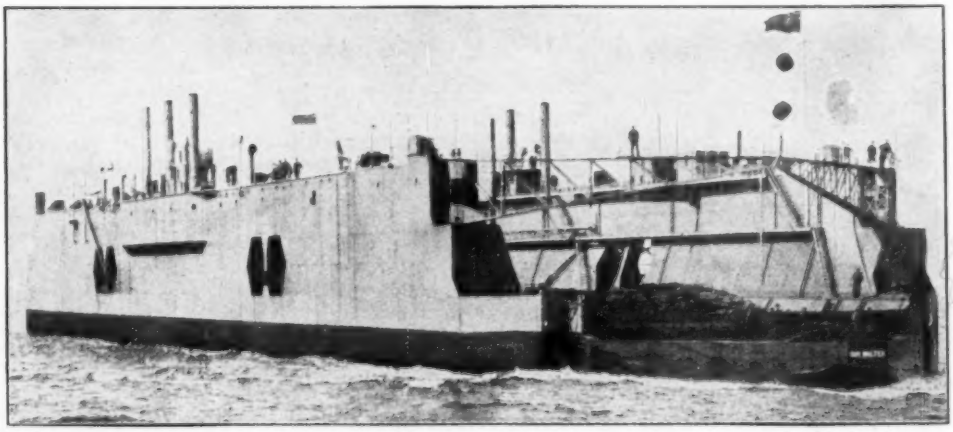
The motor developed 6 horse power and weighs 50 pounds. The balloon has a length of 75 feet and a maximum diameter of 25 feet. From the balloon is suspended the frame which supports the motor and the platform for the navigator. Dr. Greth has done away with the balloonette used by Santos Dumont and Stanley Spencer, which nitrates the hydrogen gas by mixing air with it. There is a netting over the balloon which keeps it taut on the top and at the ends preventing it from buckling. The frame is only seven feet below the balloon thus rendering the ship more dirigible.

The Scientific American says: "For 20 years Dr. Greth has taken an interest in aeronautics and has had nine patents for

airships granted by the United States. The inventor is hadicapped by lack of funds to equip the airship properly. By proper manipulation of the four propellers the balloon can be kept always in a horizontal position, can be raised or lowered and driven in any direction at will. All the inventor wants is a powerful enough motor of light weight and then he will demonstrate the practicability of his theory of navigating the air."

LATEST FLOATING DOCK FOR BRITISH NAVY.

An immense new floating dock is now in mid-ocean on its way from the ship yard on the Tyne, England, to the British navy yard at Durbin. It is 475 feet long, 96 feet wide, with 44 watertight compartments. All its pumping machinery is in duplicate. It has been built to take the place of the dock lost at sea a year ago when bound for the same destination. Page's Magazine, London, says the dock has a lifting power of 8,500 tons.



New Tyne Built Floating Dock on its Way to Durbin

KREODONE BLOCK PAVEMENT.

Kreodone block pavements are gaining in favor and are said to be more durable than granite. A kreodone block is a block of long leaf yellow pine or similar timber treated to injections of kreodone creosote oil. The pavement is successfully used in Indianapolis and other large cities. The block is wholly indifferent to wet, dry heat or cold.

Write for Pop. Mechanics premium list.

ADVANTAGES OF ELECTRIC TRACTION OVER STEAM.

Manhattan Road of New York Saves Fortunes Through the Change of Power

Superior economy of operation, greater convenience to the public and other advantages of electric traction over steam is admirably demonstrated in the case of the Manhattan Elevated Railroad of New York. In converting this system from a steam to an electric road no change was made in the tracks, rolling stock or character of traffic. The conditions aside from the motive power remained precisely the same.

During the quarter ending June, 1902, the gross earnings under steam operation were $2,857,250, while in the same quarter in 1903 the gross earnings under electrical operation were $3,271,787, an increase of $414,537. The expenses for the quarter in 1902 were $1,401,000 and for the same quarter in 1903 they fell to $1,302,000, a decrease of $99,000. The net earnings showed for the quarter an increase of over $513,000.

The public has been carried at greater speed with less crowding and more frequent service. The greater tractive power which is possible under electric traction enabled the company to run six-car trains instead of five-car trains and to accelerate the speed from 20 to 30 per cent, thus vastly augmenting the capacity of the road.

The results have attracted public interest to the greater work of electrifying the suburban lines of the New York Central, which will soon be undertaken, and to the possibilities of substituting electricity for steam on other suburban steam railroads in the larger cities of the country.

Machinery Makes Rice a Rival of Wheat in America

The South's Commercial Declaration of Independence Results From the New and Vast Industry

[By Prof. A. S. Knapp, President of the Rice Association of America]

Fifteen years ago it appeared highly improbable that rice would ever occupy any commanding position in the food markets of this country. Wheat and corn imperially controlled the situation and were dominating the markets of the world.

The spinning jenny and the power loom did not do more to enthrone the cotton industry than the machine seeder, the twine binder and the steam thresher did to make wheat chief of cereals. Rice in all this period of evolution of wheat remained stationary. Fifty years ago it was planted, harvested and milled the world over precisely as it was 2,000 years before America was discovered and to all appearances there would be no improvement for the ensuing twenty centuries.

One day some bold optimists conceived the idea that improved farm machinery could be adjusted to the rice industry. After many trials and failures it was a success. The gang plow, the horse drill and the twine binder and the steam thresher took possession of the rice fields. This involved a revolution, to-wit, the Southern states would become in the near future large contributors to the world's food supply as well as to her fiber supply.

The coast rice belt in Louisiana and Texas includes over 12,000 square miles of fairly level and very fertile prairie. Prior to the invasion of this territory by rice the land was regarded as almost worthless except for stock range. Subsequently it was ascertained that the soil was rich in plant food and that its nonproductive condition was due solely to the lack of drainage. This rice belt is bisected by ten navigable rivers and by many smaller streams; all conveying fresh, soft water comparatively free from silt. Prices of land were barely above the cost of government entry. Settlers from many sections of the country began to camp upon this territory with improved machinery. Some people shook their heads, but others shook out their plows, their drills and their binders and went to work.

In nearly every township there are one or more ridges slightly above the surrounding land. On these surface canals were built from 20 to 150 feet wide, according to the area to be watered. The sides of the canals were raised from four to five feet with plows and scrapers, or with grading machinery. Laterals were run from the main canals to accommodate remote farms. Powerful pumping plants were located on the banks of the river at the head of the surface canals.

Scarcely had the surface canals been accepted as a success when Southwest Louisiana was startled by the possibility of artesian wells.

The primitive method of milling rice was to place a small quantity in a hollow stone or block of wood and pound it with a pestle. The blow with the pestle cracked the hull, and the friction created by the sliding motion of the rice under the blow removed the hull and the cuticle. The bran and hulls were then removed by winnowing. The first advance upon this primitive process was to make the receptacle for the rice out of a short section of a hollow log, using a heavy wooden pounder, bound to a horizontal beam 6 to 8 feet long, resting on a fulcrum 4 to 5 feet from the pounder. The pounder was raised by stepping on the short end of the beam, and by suddenly removing the weight the pounder

Plowing a Texas Rice Field

Plowing Texas by Steam—Steam Traction Plowing with a 27 Horse-power Special Engine and Canto Plows was recently exhibited in a Texas Rice Field. The machine plowed eight furrows 12 inches wide at one time at the rate of three miles per hour, which is 40 acres per day.

dropped into the rice tub and delivered a blow.

Our modern rice mill is an automaton of complicated machinery into which the rough rice passes and finally appears ready for market, graded, sacked and weighed, at the rate of 20,000 to 200,000 pounds per day, according to capacity.

Thus far the evolution of rice in its productive and milling processes have gone forward with perfect success upon southern soil.

The by-products of rice are fully as valuable as those of wheat. The straw is superior as a stock food. Thousands of tons of rice straw have been sold this year in Louisiana for $4 to $6 per ton to stockmen. Rice bran and rice polish rank for food with wheat bran and wheat middlings.

It should be noted that wheat production in the United States has passed the meridian of its vigor. Many states that were once large contributors to the wheat supply do not now produce enough for home consumption. Wheat was fortunate in finding wonderfully favorable conditions on the prairies of the Northwest, but it exhausts the soil rapidly; ten to fifteen

Irrigation of Rice Fields by Deep Wells

It was discovered that there were strata of gravel at 125 to 200 feet under the entire southern rice section containing an unlimited supply of water, which would, of its own pressure, come so near the surface that it could be easily pumped. This was received with incredulity at first, but repeated tests proved that there is a bed of gravel nearly fifteen feet in thickness underlying this section of Louisiana and Texas which carries a large amount of soft water. Pipes of 2, 3, 4, 6, 8 and 10 inches in diameter have been sunk to the gravel and pumped continuously for months without diminution of supply. The water is soft, at a constant temperature of about 70 degrees, and absolutely free from all seeds and injurious minerals. Such is the facility with which these wells are made that a 6-inch tube has been put down to the full depth required—200 feet— in 14 hours.

The total cost of a well or wells and pumping outfit sufficient for 200 acres of rice is from $1,500 to $2,000, and for 500 acres about $3,500, or $7 per acre. It is probable that over 50,000 acres of rice will be irrigated by wells the ensuing season. The cost of such irrigation is from $1 to $2 per acre for the season, depending upon the cost of fuel and other conditions.

years continuous cropping reduces the annual yield per acre to scarcely paying quantities. The center of wheat production is moving steadily to the north. There is little remaining territory for it to devastate. Already it is a giant with paralyzed limbs.

Another question to be considered. Can the rice farmers of the United States, with their improved agricultural machinery, compete with the cheap labor of the Orient? On the prairie rice lands of Louisiana and Texas, one man with a four-mule team can plant and harvest one hundred acres of rice. He will require an additional man in harvesting and stacking, and, of course, help for two or three days in threshing. Well tended, his crop will net him 1,000 barrels. He may do much better than this, and he may do worse. In Japan, one-third of an acre is a reasonable rice farm for a man. In China and India, the water buffalo is used in preparing the land, which enables one man to cultivate one-half an acre to two acres, depending upon the amount of additional help employed. With our improved machinery, there is no known country where a dollar will produce as many bushels of rice as in the United States. The indications are that rice production in India and Japan will decrease. These countries show remarkable progress in textile manufactures. This indicates that much land in the near future will be devoted to the production of fiber. Every acre devoted to fiber must be withdrawn from the cultivation of rice or wheat, for every available acre in China, India and Japan is now under cultivation.

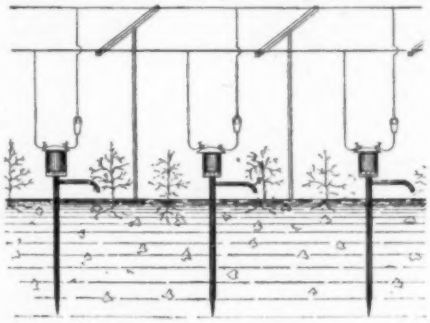
The chief interest, however, in the general planting of rice in the South lies in the fact that it will make the Southern States resourceful and independent. In the nature of things there will ever be a struggle for empire, and survival of the most powerful. The decisive battles of the future will be won, not by serried battalions with emblazoned banners amid the rattle of the rifle and the roar of the cannon, but by the industrious millions on the farms and in the factories.

Foundries and factories will come to her unsought; her cities will broaden to meet the demands of an increasing commerce, and her marts of trade will teem with merchants from every land.

An inventor in Norway has discovered a new method of making alcohol from sawdust, which greatly cheapens the process and improves the quality.

IRRIGATING WITH ELECTRIC PUMPS.

Many ingenious and unique methods of raising water are being invented, owing to the great interest in irrigation. A recent invention is intended to pump water with a large number of small electric pumps. These pumps are best suited to localities where the water is found not far below the surface. To employ this system electric



Electric Pump Irrigation

power must be available, and wires run to such parts of the place as it is desired to work the pumps. The pump and motor are incased in a metal case at the top of a piece of pipe. The lower end of the pipe is pointed to drive easily, and protected with a strainer to keep out gravel. When the pump is driven into the ground the necessary distance, wires are connected to the overhead wires, and the pump starts working. If for any reason the water supply fails, or the pump gets out of order, the motor will stop automatically.

SAYS HE WILL FLY AGAINST THE WIND.

Prof. Benedix Ben-Zoin, a Russian, who has degrees from Russian and German universities, and who practiced medicine in Armenia for ten years, coming to this country in 1897, claims to have perfected plans for a flying machine which will positively fly against the wind at a rate of 40 miles an hour. The principal features of his device are aluminum tubes filled with hydrogen, and electric motor power. He says he will demonstrate that the use of the balloon in a flying machine is a mistake. The inventor is now at Atlantic City, N. J.

A technical school for leather workers has been opened in London. Instruction is given on tanning, currying, leather dressing, dyeing, staining and finishing.

New York's Canal To Benefit All America

Connecting the Great Lakes with the Hudson River It Will Lower Grain Rates and Prove a Blessing to the Western Farmer

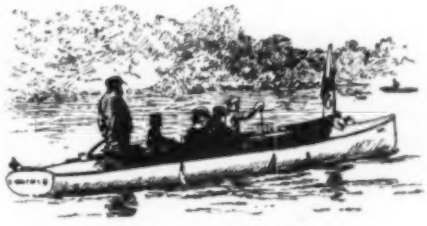
All the United States will be benefitted by the great barge canal which New York by a vote of 175,000 majority has decided to build. It is to cost $101,000,000 according to the proposition on which the vote was taken, but experts state that more than $200,000,000 must be expended before the completion of the mammoth project. This is considered a greater undertaking than the Panama Canal and its advantages will probably be as extensive. In New York City the vote in its favor was almost unanimous, but the vigorous opposition to its construction on the part of railroads caused the state, with the exception of Erie county, where Buffalo is situated and the neighboring county of Niagara, to vote against it.

New York's commercial supremacy depended on the vote that decided in favor of the canal. Because of the exorbitant rates charged by railroads New York's commerce was gradually being diverted to Montreal and other points. Great grain elevators of New York and Brooklyn had become idle and long since abandoned because of the excessive grain rates. It would have been only a short time until the railroads would have been able to make such transportation rates as they saw fit and New York City would have been still further discriminated against to the enrichment of other ports.

The canal will be of inestimable benefit to New York and Buffalo, but of even greater value to the western farmer, who may find double enjoyment in knowing that he will receive its benefits without having to pay a cent either to build or maintain it. Chicago, Kansas City, Omaha, St. Louis, Minneapolis, St. Paul and all the western cities will realize its advantages. It will give Chicago ships an outlet to the ocean and grain shippers all over the West will know the blessings of reduced rates.

Even if the canal should not act as an important freight carrier it would act as a freight regulator. And the canal's regulation of freight rates cannot be smothered by a consolidation of interests or a gentleman's agreement, because it will be state owned. There is every indication, however, that the water-way will be a most extensive freight carrier. It is to connect Hudson river with the great lakes, and is to be capable of carrying barges of 1,000 tons carrying capacity. The plan is to widen and deepen the Erie canal and to improve the Oswego and Champlain canals. The canal will be able to carry freight adapted to canal transportation at a rate with which the railroads can never hope to compete, and by the general reduction in rates New York will get back her commerce that many seaports have been enjoying.

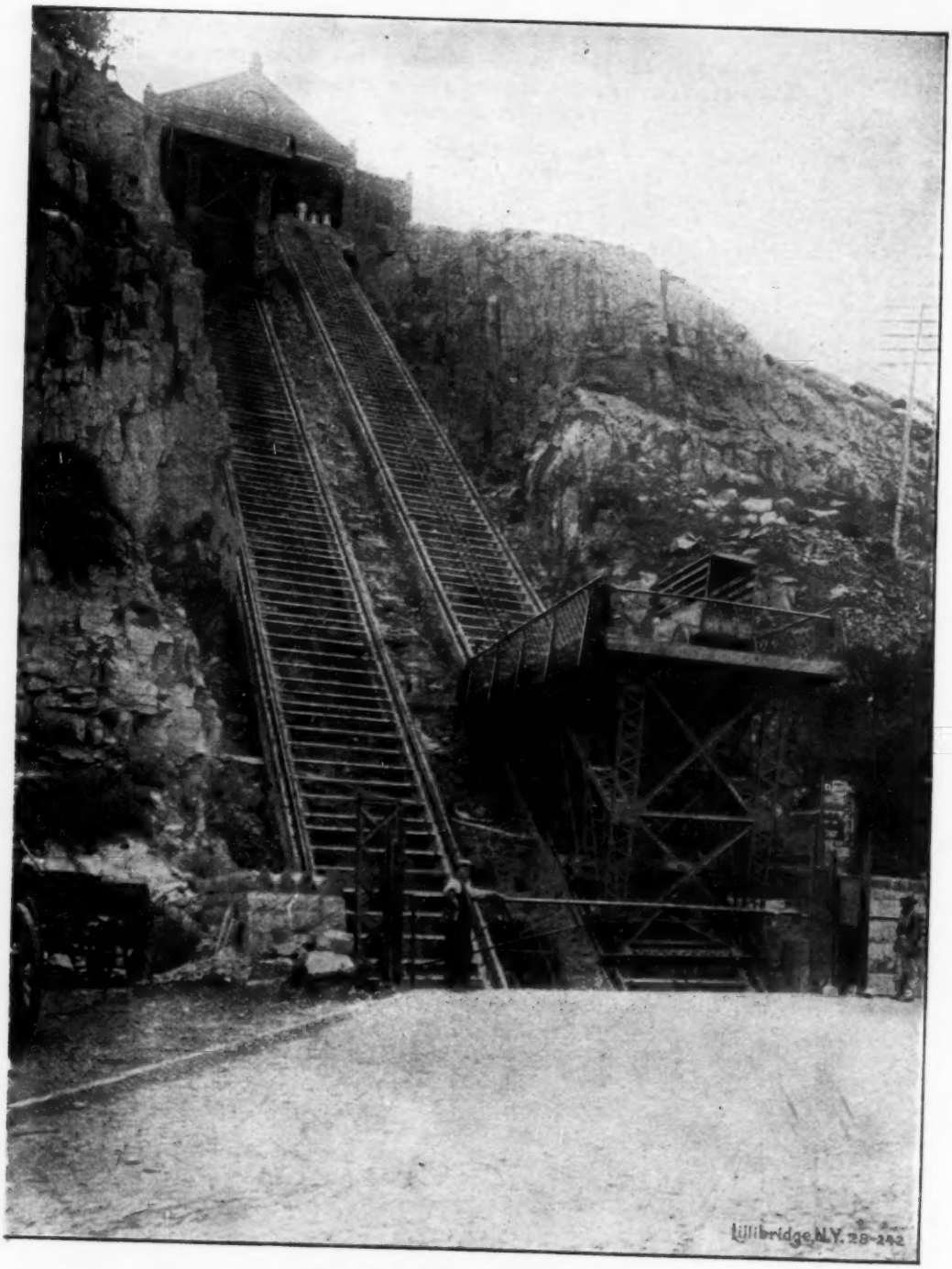
The money for digging the canal will be available as soon as the controller can sell the bonds. These run 18 years and bear 3 per cent interest. Within three months after the first issue of bonds is sold work must be begun. The governor has the appointment of an advisory board of five expert engineers at a compensation to be fixed by him. They have no authority under the act except to follow the work and advise the state officers charged with its performance, the state engineer and the superintendent of public works. The law does not require these officers to take the advice the experts may offer. Under the law the state will be allowed to issue not more than $10,000,000 of canal bonds at any one time. The vote for the proposition in New York City was almost unanimous, and New York City must bear two-thirds of the cost.



PRIZE AUTOMOBILE BOAT.

This is the automobile boat that won the prize at the recent tournament in France.

Rural parks to the number of 352 are maintained by the trolley car companies of the United States.



Weehawken, N. J., Incline Railway

Hauls Passengers and Vehicles Up a 72 Per Cent Grade

One of the queerest incline roads ever built is the Weehawken Double Track Railway. The cars for passengers and vehicles are 20 feet wide by 40 feet long and are capable of carrying a load of 50,000 pounds at a car speed of 300 feet per minute. The engines are electric and are operated by 300 horsepower motors. The height of travel of this incline is 300 feet and the grade is 72 per cent.

The enormous grade is illustrated by the queer shape of the cars, one end having to be built up to an immense height to make it level with the other end resting on the wheels.

Private Electric Plants for All

Edison's New "Charging Machine" May Place Light and Power Within Easy Reach of the Poor

By Thos. A. Edison

With the "charging machine," my latest invention, which I will be able to place on the market soon the possessor of a moderate income will be able to procure power to run an automobile, light his house and provide means of accomplishing numerous other things for which electricity is available. The selling price will not be more than $450, which I am sure will be lessened in a short time.

It has always been my desire to bring the use of electricity within the reach of men of moderate means. I want to see the homes of men and women who work for nominal salaries and whose incomes are small, lighted by electricity.

I want to reduce the cost of such pleasure and pastimes as are afforded by electrical power to the size of the pockets of the moderate poor. There is a little shed in my laboratory building, which is about 15 feet in length by eight feet wide and sufficiently high to permit a man to stand upright within it. If you owned a little house with a little shed like that in the yard you can with the aid of the "charging machine" at a trifling cost keep a runabout automobile, supply it with power, light your house and furnish your own electricity all from beneath the roof of that little shed. You would be absolutely independent of the electric light companies.

The batteries can be stored and restored as often as necessary with the little machine at the farther end of the shed. A child or a maid servant can operate the charging machine.

The expense for charging them, after you are once supplied with the batteries and the machine for generating the electricity, will be less than running the same number of lights with kerosene oil. The batteries are practically indestructible. I am convinced from their action during a period of one and a half years that they are three times better than any automobile that is made. I mean by that that they will wear out half a dozen automobiles, besides lighting the house while they are doing it.

There is one thing connected with this subject which I wish to be thoroughly understood. I don't expect to supply the world with the machine I am describing today tomorrow, next week or next month. Things cannot be manufactured for the market until there are machines to make them, and often it is a greater task to get the machinery and tools together for their manufacture than it is to make the thing itself.

I cannot supply the demand for my storage batteries simply because I have not the capacity for turning them out. I haven't been able to reduce the first cost of them materially as yet, because I have not been able to supply the machinery in this factory that is necessary for that reduction.

I know now that I can make that machine at a selling price of $450. I also know that I will not be able to make one to sell anybody before next spring at the earliest, that it may cost me more at first, but ultimately it won't cost any more than $450 when I am ready to sell it.

The truth about all the great inventions, discoveries and improvements is related in Popular Mechanics. The articles are concise and interesting.

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TO TELEPHONE TO LONDON.

Line From New York May Be Followed by Telephonic Connection with All Great Cities

Telephone service between New York and London is to result from a recent English invention, according to present plans. It is expected that the service will be installed within a year, when, it is declared, it will be as feasible to converse by telephone between the world's two greatest cities as it is now across Manhattan. The invention is said to have already been tested in Europe with perfect success.

From the same sources comes the promise that by New Year's direct telegraphic communication without intermediate repeating stations will be established for the first time between New York and London and telegrams will be exchanged at a speed of more than four times the speed of any cable. As a matter of fact, London scientists say the problem of rapid communication between London and New York has been solved recently in actual practice at moderate cost and the credit of this signal triumph of modern science also belongs to England.

Following the establishment of the telephone and the rapid telegraph service between New York and London it is proposed to have all the large cities of the world so connected, regardless of the seas and oceans intervening. In a short time, if this be true, it may be possible for a person in New York, or Chicago, or St. Louis, or any of America's cities to ring up London, Paris, Berlin, Hamburg, or any city of Europe and converse over the telephone as freely as they do now with persons in the same town.

THE EYES OF A SUBMARINE.

What has troubled the engineers operating submarine boats was the necessity for coming to the surface every time an observation above the surface was desired. This operation takes time, causes delay and in time of action would very likely jeopardize the safety of the craft. A vertical telescope called a "periscope" now enables surface observations without exposing the hull of the craft.

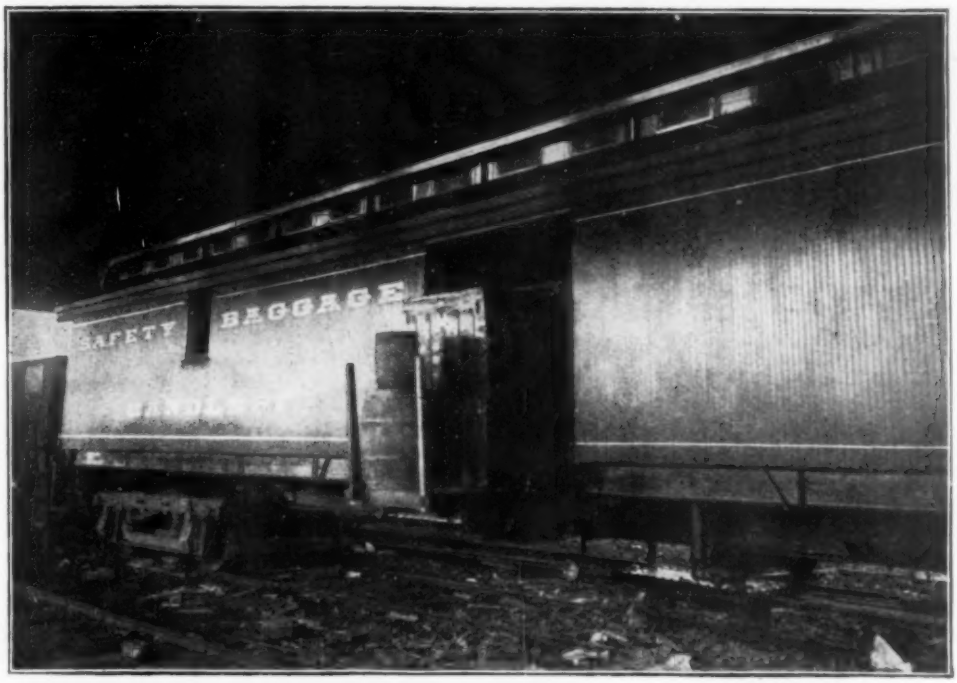
The Shipping World, London, states that the periscope is being placed on the English submarines, and adds: The periscope is an apparatus by which the commander of a submarine may scan the horizon whilst the vessel herself is under water; this is accomplished by means of small mirrors arranged at opposite ends of a tube, which is of sufficient height to reach from the submarine to the surface of the water. By turning this tube around and examinging the image given on the lower reflector, the captain can study the surface of the sea as well as if he were on the deck of an ordinary ship, while at a short distance away the tubes are scarcely discernible.

EVERY month some new and great discovery, invention or improvement is recorded in Popular Mechanics. Our readers are familiar with the mechanism of wireless telegraphy, the wonders of radium, the phenomenal speed of Germany's new electric cars, the construction of submarines, torpedo boats and battleships, the performances of airships, dirigible balloons; the construction of canals, the making of electrical devices and other such subjects. Isn't this kind of information more elevating, more instructive and more entertaining to the civilized than reading of murders, divorces, suicides and social sensations?

Sounds The Baggage Smasher's Knell

Novel Air Elevating Device That Unloads 12 Trunks in 15 Seconds

The day of the baggage smasher is nearing its close. An anti-baggage smashing baggage car has appeared. In tests on the Michigan Central and the Central Railroad of New Jersey it met with such phenomenal success that its adoption by all the leading railroads is predicted. Not only does the car prevent baggage smashing but it revolutionizes all the old methods by its wonderful celerity of operation. Fifteen seconds is all that is required to unload a truck of baggage and have another truck in process of loading. These reforms all result from a patented air power elevator.



Safety Baggage Handler

Part of the floor of the baggage car virtually becomes an elevator. Baggage is loaded on a truck and wheeled to the elevator while the car is in transit. When the train stops at a station a side door is opened, the elevator is lowered to the depot platform and the truck sent to the baggage room. Similar trucks are kept at all stations and loaded with the outgoing baggage before the arrival of the train. It is the work of an instant to run one of these loaded trucks upon the elevator, and in one and a half seconds it is in the car. The baggage is removed and sorted after the train starts.

The trucks are padded to prevent possibility of injury to baggage. The truck will carry 12 large trunks with a combined weight of 1,700 pounds. It is raised and lowered by means of 70 pounds air pressure taken from the engine and stored in a cylinder underneath the car. The air is controlled by a lever at the side of the car door and operates the elevator by means of steel cables.

The entire baggage car has an under frame of steel which makes it practically impossible to telescope the car by collision. Two 24-inch and one 20-inch I-beams constitute the center strings, supporting 9-inch I-beams as side sills. The car is 67 feet long, weighs 80,000 pounds and has 60,000 pounds capacity.

The elevator-truck is known as the

"safety baggage handler," and is the ingenious conception of George H. Wall, of Grand Rapids, Mich.

The Railway Conductor says: The car is so constructed that in the middle at the baggage door the floor is an elevator platform, five feet square, on which are rails for the baggage truck to run. This truck is six feet long and four feet wide and has 8-inch wheels. On this track, during transit, the baggage or express is placed. When the train stops, the elevator platform is instantly thrown into position by a lever and as a reduction of air is made, the truck is lowered to the platform, where it is unloaded and loaded. By air being applied by the baggageman the truck is elevated to a level with the car floor and pulled in. The car made its first trip August 18th, last, between Detroit, Bay City and Saginaw, and has not lost a trip or had any accident.

SCREW PROPELLER OR "WATER BICYCLE."

To increase the speed of the swimmer so that he can move with the rapidity of a boat, a Chicagoan has invented a screw

Swimming with Aid of Water Bicycle

propeller or "water bicycle," which, it is said, makes physical training unnecessary to become a rapid swimmer. The device is simply a screw propeller attached to the man instead of to the boat and any one who can ride a bicycle can become proficient in its use.

Another swimming device for attaching to the feet of the swimmer is constructed on the principle of a duck's foot. It is made of aluminum and consists of two flat blades or wings connected by hinges. When

Swimmer's Pedal Attachment

the foot is drawn up or forward the wings close, offering little resistance, and when the foot is thrust away from the body the wings open, offering resistance which pushes the swimmer along.

REPAIRING A CRANK PIN.

Passing through the engine-room of our factory one day recently, I found the engine pounding badly, and on having the engineer shut down, discovered that the crank pin was very loose in the disk, says a writer in the American Machinist.

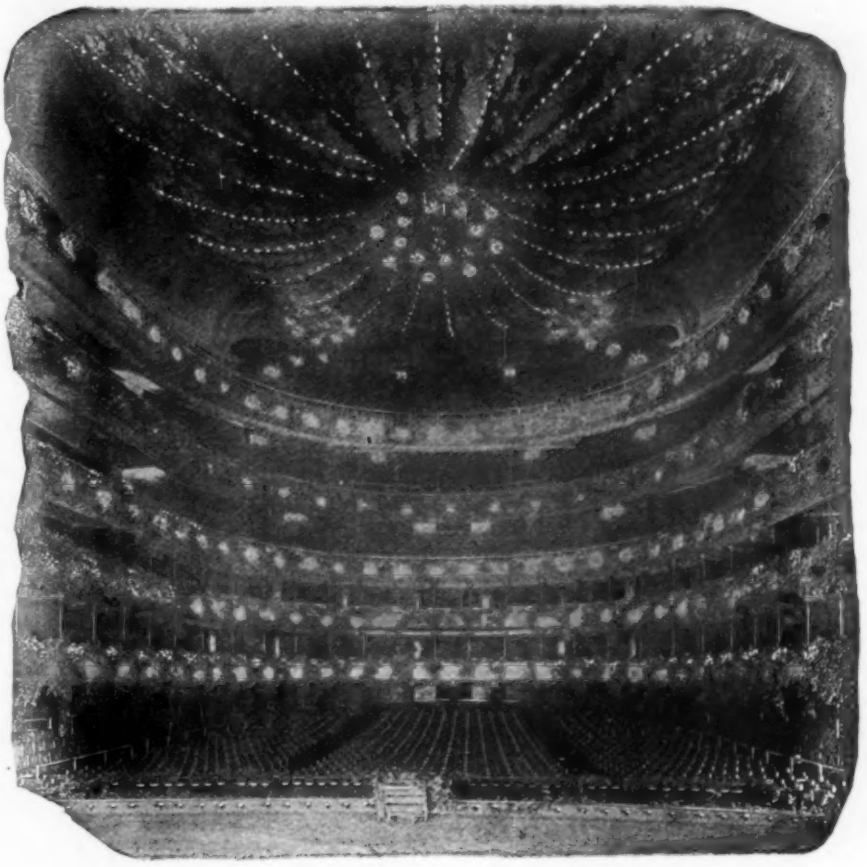
As we were too busy to shut down for any length of time, I decided to make a quick repair job. We first chipped the head off the pin where it had been riveted into the disk, and drove the pin out, then drilled a hole in the end of the pin and tapped it out with a ½-inch pipe tap. Next we turned up and threaded a tool-steel plug to the same taper as the tap, but large enough so that it would enter only two or three threads. We then cut four slots in the pin nearly to the shoulder, and drove the pin into the disk. The final act was screwing the plug in very tightly, thus expanding the pin in the disk until it was tight. As there was no room between the disk and the bed of the engine, we broke the plug off with a hammer. The results were entirely satisfactory.

The condition of the manufacturing and industrial concerns in Germany shows great improvement. For the first time since 1900 the railways report a car shortage. Mines are being re-opened.

New Light Makes Illuminations Gorgeously Resplendent

Like Drawing Designs in Fire, So Simple and Effective is the Process

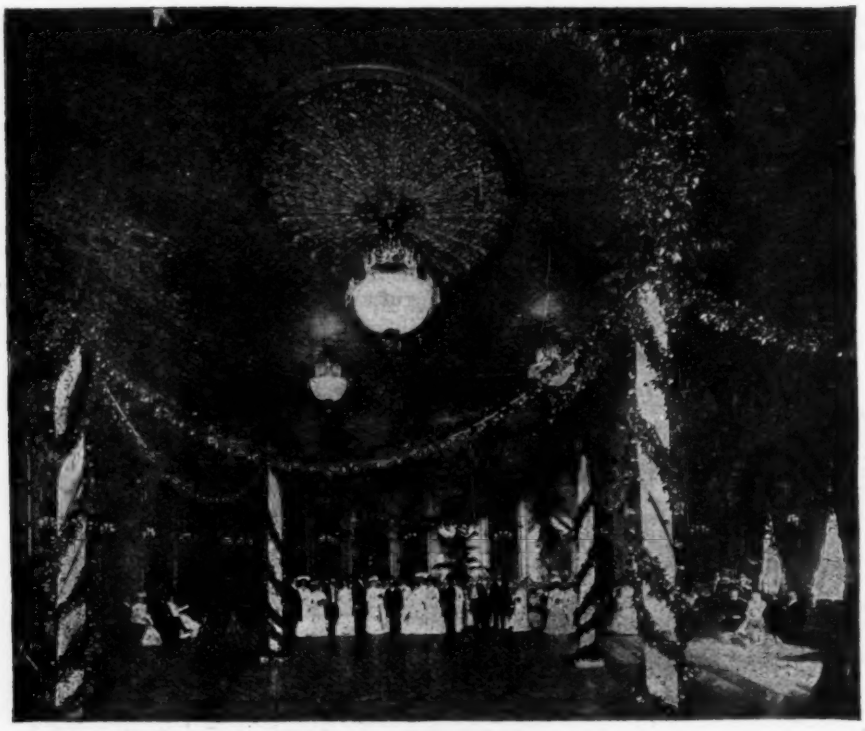
"Wherever you stick the lamp it lights." String the flexible cable up in straight lines, in garlands, festoons, concentric circles—in any form—on buildings, on yachts, from tree to tree, in the shrubbery, on the ground, through and around flower beds, about fountains, on the banquet table, in



Splendid Illumination of the Metropolitan Opera House, New York

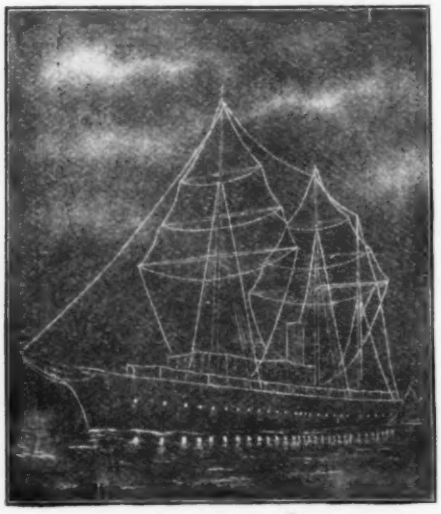
and about and around the banquet hall, in the theater, in the ball room, in the church—anywhere, everywhere—and stick the lamps on wherever you desire, as thick as you desire and they will light. Or stick the lamps on specially prepared boards, table tops, frames, etc., and with them describe circles and curves, angles or any designs you please, and they will glow forth in lines of light just as you place them. You can describe as many and artistic designs with them as you can with the painter's brush. It is like painting with light in red, yellow, green and other colors—painting with electricity instead of with paint.

The lamps used in this wonderful new process—it is called the Elbright—are provided with stickers or pins instead of the old-fashioned screw base. It is easier to form a design with them than with the paint brush, for it is sometimes difficult to



Ball Room Decorations

efface the painted mark, while with the electric lamp, if you do not like the place where you have stuck it, you merely have to pull the lamp out and stick it in another place and the light, of course, goes with the lamp.



Electric Decoration of Yacht

The cables and electric boards on which the designs are wrought are specially prepared by the company. You may procure all the lamps you desire and work out the designs according to your own ideas.

This is the way some of the most magnificent of the recent electrical displays of New York and Chicago have been produced. The invention that makes these things possible would have been looked upon as a fairy dream a few years ago. It is new and extremely novel and leads to possibilities limited only by the imagination. One of the illustrations shows the decorated dome of the New York Chamber of Commerce. During a recent celebration in the Metropolitan opera house 20,000 feet of electric cable were used; 8,500 4-candle-power lamps; 4,250 white frosted and 4,250 green frosted lamps—17,000 lamps in all. From the ceiling hung 1,500 lamps, from the proscenium arch 3,000; on the moving curtain there were 3,000; royal box and lobby, 1,000. The work was installed in 14 hours by 20 men, of whom 18 had never before seen the system.

The new invention brings maritime decorations into a prominence not thought of before. For yachts of all kinds it admits

New York Chamber of Commerce Illumination

of most splendid possibilities. Being thoroughtly salt-water proof, unending changes can be made rapidly without expense or loss of time. The locking cap of the base prevents the lamp from being blown out of position in the strongest winds. The cables are of great strength and require no guy wires. An entire ship decoration can be easily and quickly stowed away in a very small space.

Wherever You Stick the Lamp it Lights

Sir Edward Fry says 450,000,000 years must have elapsed since the existence of life on the globe.

NOVELTY IN LUSTERING FABRICS.

Moniteur de la Teinture of Paris says: Since the recent rapid development of mercerization the process has found many applications in lustering yarns. On fabrics, however, the luster has not yet been obtained, except on printed spots, and on them them luster is much impaired by the necessary use of thickening.

A new method has been invented to produce a maximum of luster on unbleached fabrics by an opposite process, that is, by retaining at the printed places the dull appearance of unbleached fabrics and lustering the unprinted places in a mercerizing bath. The fabric, having been printed with a varnish not acted on by caustic soda, is mercerized when the varnish is dry. The caustic soda lye is used of different strengths, according to the composition of the fabric, and the time of immersion depends on the same. The fabrics are then rinsed, dried and passed through a benzine bath to take off the varnish. The unprinted places then apear with a luster greatly enhanced by contrast with the dullness of the printed spots, and the fabric has the character of a real novelty.

Umbrella Sail is at Last a Reality

Accelerates Speed, Removes Danger of Capsizing and Adds Manyfold to the Yachtman's Pleasures

At last the umbrella, or cyclone, sail is a reality. Time and again attempts have been made to construct a sail of this kind, but not until the past summer have the efforts been satisfactory. The umbrella sail, which is an English invention, is attracting attention of yachtsmen in all parts of the world. With this type of sail a small boat, which could not safely carry to exceed 200 square feet of canvas with an ordinary rig, can carry 360 square feet without danger. In fact, the risk of being capsized is practically removed, while the increased speed of the boat is nearly in proportion to the increase in her canvas.

On the front cover is shown the original boat put in service this year at Cowes, England. This boat is only 17 feet on the water line, but carries an umbrella sail which measures 30 feet horizontally and 16 feet up and down. The sail also serves as an immense awning. The American Shipbuilder says the chief feature of the cyclone sail, which is practically a large umbrella, is that the wind pressure on it has no effect whatever to incline the boat. Roughly speaking, the pull of the sail is at right angles to its mean surface, that is to say, in the direction of the mast.

In other words, it may be described as a kite held by a rigid string. If the mast were stepped quite on the lee side of the boat, it is evident that the sail would lift the lee side and so list the boat to windward; and if the mast were stepped on the weather side, lifting the weather side of the boat, it would necessarily list the boat to leeward. It follows then that there is some certain point which happens to be slightly on the lee side of the center line at which, if the mast is stepped, there will be no tendency for the wind to careen the boat at all. When actually sailing in the boat, the only way in which one is aware of a puff of wind is by noticing that the boat travels faster, and experiencing a slight sensation similar to that coming from the acceleration of the engines in a steamer. For sailing with the wind in different directions to the boat the whole mast and sail are rotated by means of a turn-table to which the mast is attached, and the mast is elevated and lowered by means of two tackles. There is also a balance-weight which helps to elevate the mast and balance its dead weight.

The Thornycrofts, the great English boat builders, are experimenting in the expectation that the umbrella sail can be adapted to row boats, canoes and other small craft.

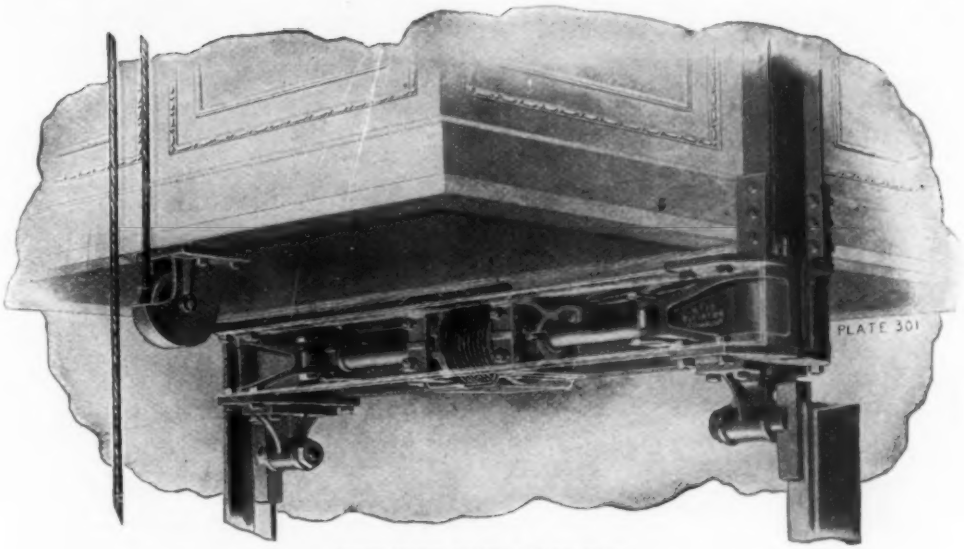
TRAINED EYE SAVED HIS TRAIN.

Engineer Rushed Past Danger Signal and Frustrated An Attempted Holdup

By pulling the throttle wide open and driving his train swiftly by a danger signal set dead against him, Engineer George W. Boss frustrated an attempted holdup of the New York, New Haven & Hartford Express. Four cars full of passengers, unconscious of the peril met and avoided were landed safely at the R. I. depot, while the engineer repaired to the office of Superintendent A. R. Whaley to report that he had matched his orders against the ironclad orders of the road and won

The train had reached a point within an eighth of a mile of Plummer's Ledge, where Engineer Boss saw a green signal light, indicating a clear track. Suddenly it changed to a red light and the engineer closed the throttle and set the air brakes. As he did so a lantern was swung across the track, but not in the easy manner acquired by experienced tracksmen, and it flashed across Boss' mind that the man who gave the signal was not stopping the train for any good purpose. For a second he hesitated, balancing in his mind the possibility of wrecking his train and the probability of his passengers being robbed and perhaps killed if he brought it to a stand still.

As far as he could see an unobstructed track lay before him. Another second and his mind was made up, and he rushed the train past the danger signal. Leaning out of his cab Engineer Boss saw the man with the lantern jump from the track. Two masked men were standing on the ladder holding the stationary light and tampering with the signal, while seven other men were lined up along the roadbed.



Safety Clutch for Steel Guide Posts

The Elevator and Its Many Uses

Swift Passenger Cars That Tour the Sky-Scrapers and Freight Cars for all Kinds of Hoisting Traffic

For lifting ashes from the cellar to the sidewalk and for hoisting persons to the top of towers surmounting the modern 20 or 30 story sky scrapers! These are but two of the uses for which the elevator of today is employed. To name all its other fields of service, would be to enumerate the various enterprises of America. In the freight house, in the coal mine, at the steamship dock, in the machine shop, in the railway and steamship yard, in nearly every kind of factory, in the live stock markets, in fact wherever lifting is to be done the elevator is now used. Not so many years ago it was regarded as a curiosity. The sky scraper gave prominence to the elevator and greatly widened its field. It is used more in America than in any other country, because there are more tall buildings here than in any other country; because there is probably more lifting to be done in America than in any other country, and because Americans prefer quick and convenient ways of doing things. In Europe the elevator is called a "lift."

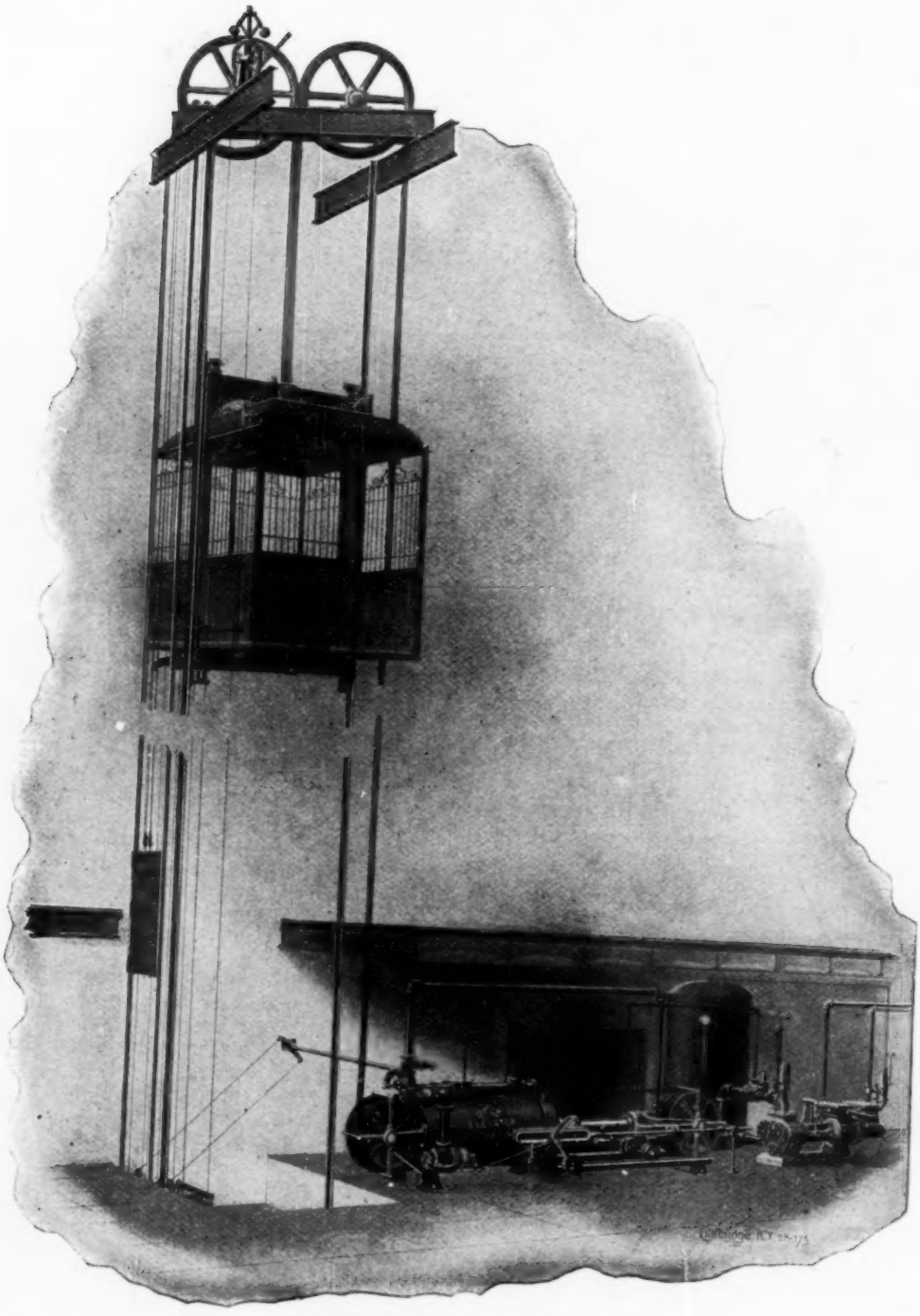
THE SKY SCRAPER ELEVATOR.

The mechanism of the sky scraper elevator is shown on page 328. It is a wonderful machine that can shoot past the floors in its passage between heaven and earth at a speed of 800 feet per minute. This is the famous hydraulic elevator of the vertical cylinder type invented by the Otis company. The engine is provided with a simple device which limits to a predetermined speed the rate at which water can flow into and out of the cylinder. This enables its speed to be regulated when desired, and there is no possibility of the car moving at greater than the fixed speed, when it is descending with a heavy load, for instance. The safety clutches can be set to operate at a speed slightly above this rate and will come into action only in case of emergency.

The illustration shows the controlling lever in the car which operates the pilot valve connected to the main valve of the elevator engine. This machine may be geared as high as 8 to 1. It can be operated with any convenient water pressure.

HORIZONTAL CYLINDER TYPE.

The illustration on page 326 shows the horizontal cylinder type of hydraulic elevator, designed for buildings where it is deemed advisable to install all the elevator machinery in the basement. In smoothness of operation, speed, safety and other requisites of a high class elevator it is equal to the vertical cylinder type, and the question of which is best adapted to the building in which the installation is to be



Horizontal Cylinder Hydraulic Elevator

made should determine the type of machine.

For buildings of considerable height these elevators are geared as high as 12 to 1. Where several are to be installed the cylinders may be placed one above the other in a "double deck" or "triple deck" arrangement, thus further economizing floor space. The illustration shows, in connection with the elevator, a compound-duplex elevator pump, compression and discharge tanks and the necessary piping connections. The tanks are shown in the basement but in large plants, especially, it is often found more convenient to place the compression tanks in the atic.

Depot Entrance Glasgow Harbor Tunnel.—Elevating Teams and Loaded Wagons

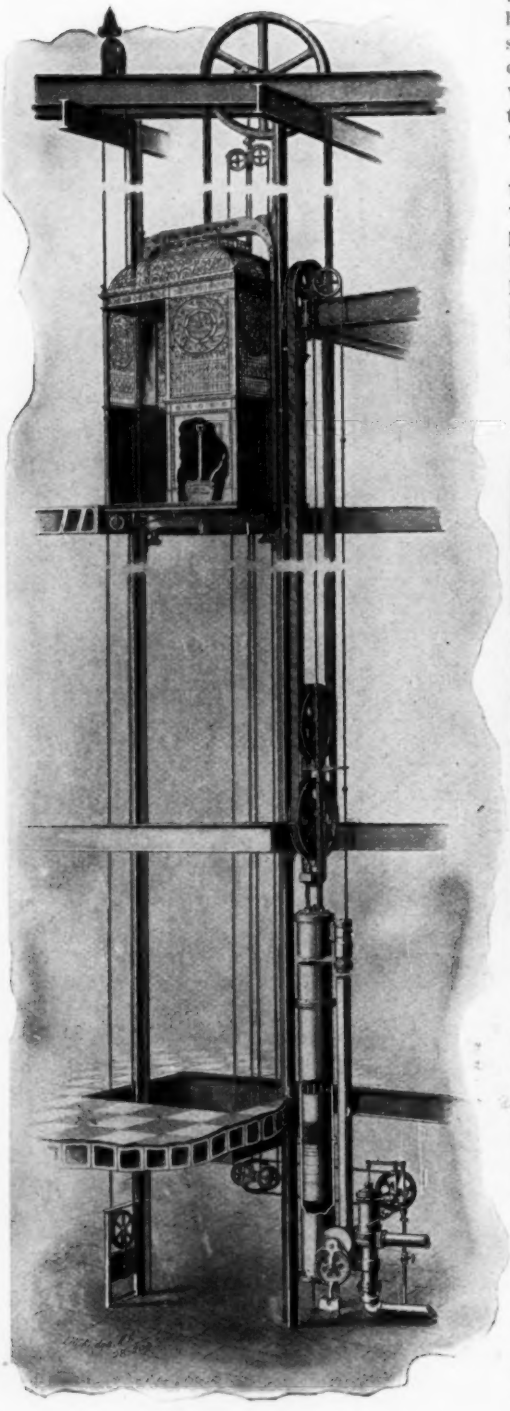
SAFETY APPLIANCES.

While the factor of safety in the construction of the modern high-class elevator is considerably in excess of any strain to which they may be liable in their operation, each elevator is provided with special safeguards against all known forms of elevator accidents.

The governor is located at the top of the elevator hatchway and is suitably connected to the car, entirely independent of the lifting cables. Should the elevator car for any reason, exceed the predetermined speed for which the governor has been set, the powerful clutches located beneath the car, grip the guide posts, bringing the car to a safe and easy stop. The form of grip shown in the illustration on page 325 is used with steel guide posts.

AMERICAN GENIUS AIDS GLASGOW.

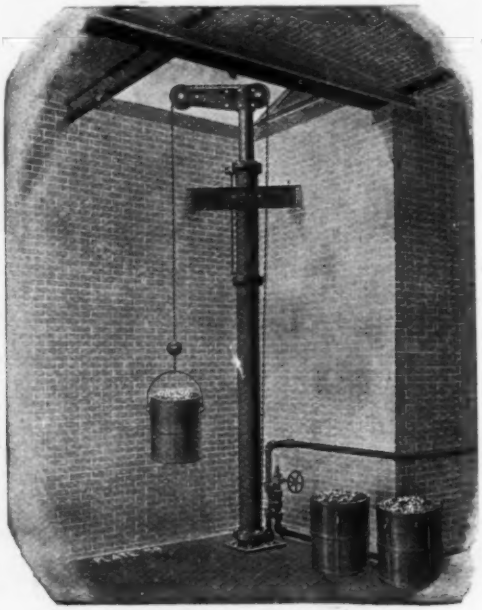
All kinds of trouble was experienced with



Vertical Cylinder Hydraulic Elevator

the handling of freight in the Glasgow harbor tunnel until an American company solved the problem by the employment of elevators. With these the freight from the vessels is loaded into the wagons and then the wagons and teams are lifted by the elevators to the street level.

The entrance to the harbor tunnel elevators is shown on page 327. The elevators were built by the Otis Elevator Company. The plant consists of twelve elevators, having a car travel of 80 feet. The platforms are ten feet wide by 28 feet long, giving a lifting capacity for wagon and team of horses at a car speed of 250 per minute. The levators are operated under



Hydraulic Ash Lift

the high pressure hydraulic system, using steam pumps and accumulators. The hydraulic pressure is 800 pounds.

A hydraulic ash hoist for raising ashes from the cellar to the sidewalk is shown in the last illustration. It is extremely simple in construction and very compact.

Santos Dumont's newest machine is the "Santos Dumont No 10" which he tested a few days ago. This machine may be brought to the St. Louis exposition.

Nobody had any idea that germs were so good to eat until it was learned that more than 60,000,000 of them are to be found in an adult oyster.—Kansas City Star.

Young Women's Cooking Class at Pueblo, Col.

Necessity of Industrial Training of Children

Ideal School in Colorado in Connection with a Great Manufactory

[By R. W. Corwin, M. P., Supt. Sociological Department, Colorado Fuel and Iron Co.]

The chief agency of popular education will be the very labor through which life is sustained. Industry employs the mind that its work may be intelligent; it provides for moral training in that its work must be sincere. "Man without tools," says Carlyle, 'is nothing; with tools he is all." In Ruskin we read: "A boy cannot learn to take a straight shaving off a plank, or to draw a fine curve without faltering, or to lay a brick level in the mortar without learning a multitude of other matters that books could never teach him." Says Professor Henderson: "The richer and more varied these impulses or sensations, the richer and more varied the stream of thought. With meager sensation comes meager thought." J. E. Painter has written: "By wise direction or supervision his powers of initiative are developed, his individuality cultivated." Training the hand, when accompanied by mental exertion, trains the brain, and if the work be sufficiently varied the mental development is well rounded.

Along with industrial work of all varieties there is one thing we should never lose sight of; that is the recreative or pleasurable aspect of work. All work should be a matter of pleasure, not of drudgery. To some this may seem absurd at first thought, but let us analyze the meaning of work, and see if it should not be considered a privilege rather than a hardship to work. "Work implies continued exertion or activity directed to some purpose or end." There must be an object. Work becomes distasteful when it is unaccompanied by mental energy and intelligence. Knowledge makes work a pleasure. It robs it of drudgery. If work and thought be properly associated, no matter what the task may be it is accompanied by enjoyment. This is the secret in all work.

Industrial training should be taught so the child will love to work. A teacher of industrial training devoid of this power will meet with failure, and the child will learn to hate work.

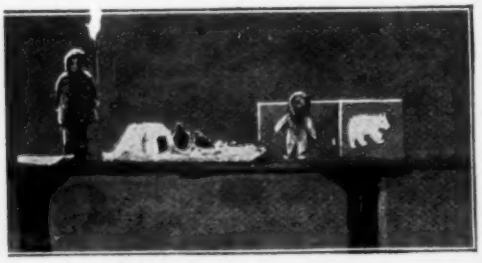
Germany, Russia and England are far in advance of the United States in schools for training workmen, and France, Switzerland, Sweden and Denmark lead us.

The position of our country has been

maintained by the importation of skilled labor and by American mental shrewdness and capital. We must look to our laurels or fall by the wayside, and be numbered with Italy and Spain. Every person can do

Child in Colorado Fuel and Iron Company Kindergarten Weaving a Basket

something, if no more than to get out of the way of others. Every community, association or corporation may assist. Of course these conditions in the United States will change as we learn and realize.



The Esquimaux and their Homes—Kindergarten Construction Work, Engle, Colo.

In the kindergarten of a certain Colorado corporation the children are doing individual industrial work in weaving, sewing, basketry—they make several varieties of baskets and mats from reeds and raffia and native grasses—in cutting and pasting—elementary operations essential to actual construction work—and work in colors. They have also been studying the work of the blacksmith, the baker, the grocer, the shoemaker and the carpenter, the benefits we derive from their work and our dependence upon it. This is collective industrial work. They make out of cardboard, clay, tea-lead, and certain materials the children bring from home—the blacksmith shop with forge, horseshoes, nails, anvil and clay horse and blacksmith. Even the sign outside of the door is not omitted. Similarly they study and reproduce the other familiar occupations.

In all this work, however, care is taken that there be no taxing of the nervous system by requiring too minute and precise work, too delicate co-ordination.

For the older children industrial clubs are provided. In some camps these clubs are making reed and raffia baskets of all sorts—work baskets, waste-paper baskets, and long flower baskets with handles. At one camp they are doing practical work in weaving, having manufactured their own looms. At another they are making a specialty of wood carving. Beginning on small household utensils, they will go on to the practical manufacture of furniture, cane bottoms for chairs and other such useful

Junior Sewing Class, Harmony Hall, Starkville, Col.

Finished Products of a Basketry Class at the Engle Kindergarten

articles. At still another we hope to introduce burnt wood work.

For those whose work gives promise of extraordinary talent, the central industrial plant at Pueblo will offer opportunities for advancement. At this plant will be given also courses in cooking and sewing for the wives and children of employes at the steel works.

Cooking and sewing are being introduced as rapidly as teachers can organize classes, conduct a brief course in each place, and instruct the local teachers. At one camp (El Moro), Peno, the thirteen-year-old son of a saloonkeeper, one morning offered to get breakfast for the family. He prepared coffee and cakes, and the father was so delighted with them that he invited all the early morning saloon patrons in to breakfast.

In sewing the children are learning to baste, hem, overcast and stitch by hand. They are now to commence cutting out garments, drafting their own patterns from a chart. Later they will learn all the parts of a machine, how to keep it in order, and how to use it in making garments.

Upon the germ depends the beginning—upon the germ and training depends the end. A poor germ makes a bad beginning; a bad beginning is a handicap against after training. The right start leads to a successful finish. Today's boy is tomorrow's man. If we care for the boy, the man will require little attention.

Cooking Class for Nurses at the Colorado Fuel and Iron Company Hospital, Pueblo

HE SWUNG THE LANTERN.

Senator Daniel, of Virginia, was at one time counsel for a small Southern railroad. At a point on the line where it crossed a prominent highway they had an old negro watchman, whose duties consisted in warning travelers of the approach of trains. One night a farmer's wagon was struck, causing a bad accident. The railroad company was, of course, sued for damages, and at the trial the old darkey was the chief witness for his employers. He answered the questions put to him in a clear, direct manner. Among them was the query as to whether he surely swung his lantern across the road when he saw the train coming, to which he replied:

"'Deed I did, sah."

The railroad company won the suit, and Mr. Daniel took occasion later to compliment his witness on his excellent testimony. The old fellow was profuse in his thanks, but before they parted bluntly said:

"Lordy, Marse John, I sho' was skeered when dat lawyer 'gin to ax me 'bout de lantern. I was feared he was goin' to ax me if it was lit or not, 'cause de oil in it done give out some time before de axedent."

LUNCH AT THE BOTTOM OF THE SEA.

Capt. Lake gave a luncheon at the bottom of the ocean near Newport, R. I., recently inside the submarine torpedo boat Protector. The luncheon was cooked inside the boat while a brisk gale was kicking up a rough sea overhead. A party of naval officers were the guests at the submarine feast. The boat was submerged for one hour and three-quarters.

Kite Hauls a Boat Across The English Channel

Queerest Craft that Ever Sailed Successfully Crosses the Turbulent Water

Hauling a boat by kite is a new feat that has been successfully performed in Europe by S. F. Cody. After several attempts Cody crossed the English Channel in his kite-boat, leaving Calais at 11 o'clock p. m. Nov. 7 and reaching Dover 13 hours later. Mr. Cody encountered much shipping and some narrow escapes.

The kite employed was on the principle of a box-kite and was capable of hauling

Experimenting with the Man Lifting Kite that Hauled the Cody Boat

quite a load. The boat weighed four tons and was decked with canvas. It somewhat resembled a miniature submarine boat. A combined steering gear manipulated the kite and the boat's rudder alike and en-

Launching the Cody Boat

abled Cody to guide the craft with comparative ease.

Mr. Cody has a scheme to reach the North pole by means of this kite. He says that Nansen's progress toward the pole was stopped by a huge wall of ice 125 feet high. He could not surmount an obstacle of that size and had to turn back. With this kite, Cody says, the sledges and provisions could be lifted over the ice, together with the explorers.

Nansen's dogs died and transportation became almost impossible. With the kite, Cody says, Nansen would be independent of dogs, for in favorable wind the kite would draw the sledges along. Three or four kites would drag a ton weight of material, including three men.

The kite with which Cody crossed the channel was connected to the boat by 3,600 feet of piano wire.

YANKEES NEGLECT SMALL TRADE.

South African Exports says: "The Yankees do not appear to be making much headway in the engineering line as far as Cape Town is concerned. The 500-horsepower generating set lately installed by the corporation is entirely of British manufacture, while the machinery for the new electric light stations at Claremont and Wynberg was also made in Great Britain.

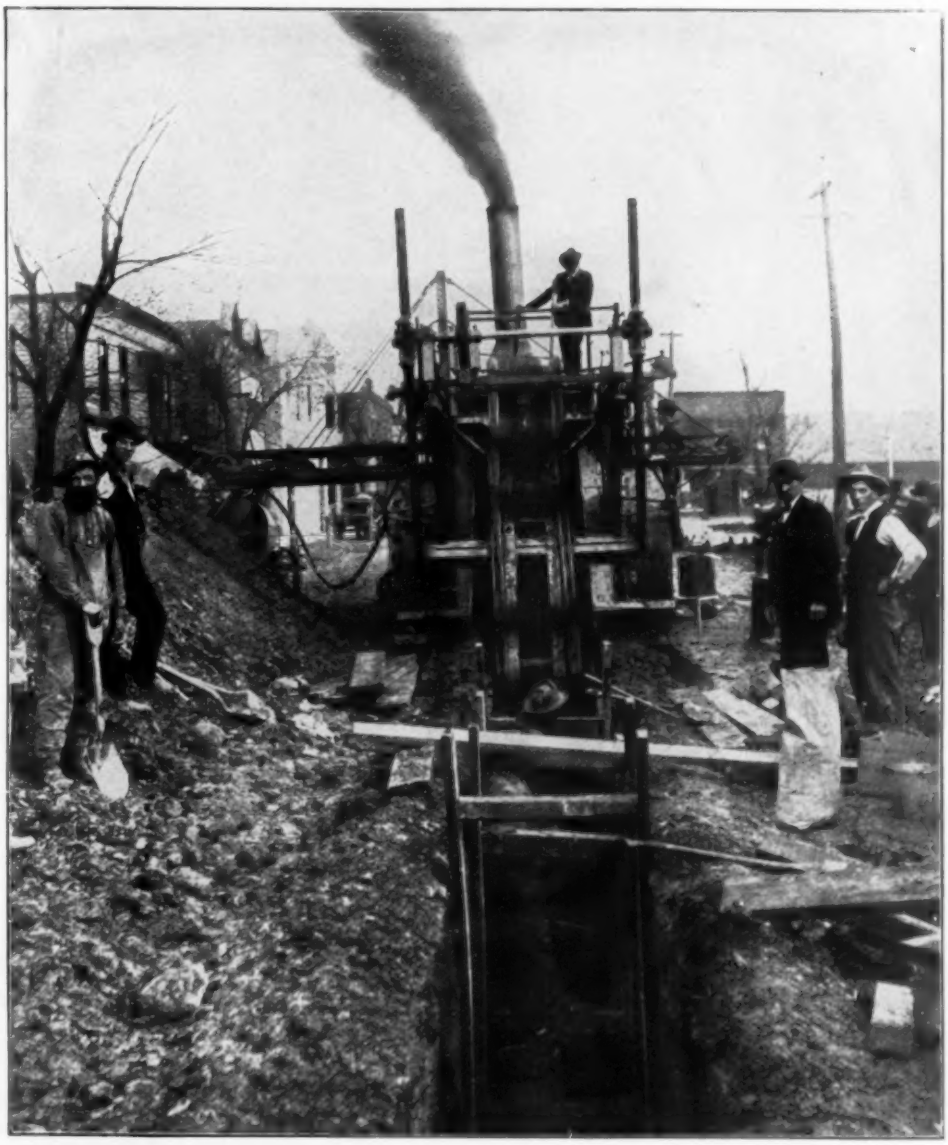
"In Johannesburg, where there is a wider field for this class of work, there is a different tale to tell. Most of the big American houses have branches or agents in the Golden City, and are making desperate efforts to capture the trade by cutting prices. When it comes to a question of prompt delivery it is not unlikely that the British manufacturer may feel the pressure, though so far few contracts have been missed through this cause. Just now both parties are merely marking time, as until the labor question is settled there will be little demand for machinery. Owing to the deadlock in the mining industry many tenders for big orders have remained unopened, and will not be considered until an improvement sets in."

Claus Neelson, whose farm near Omaha, Neb., is a general landing place for balloons after exhibition ascensions, has obtained an injunction restraining balloons from "descending on his farm or property, from destroying his crops or frightening his live stock."

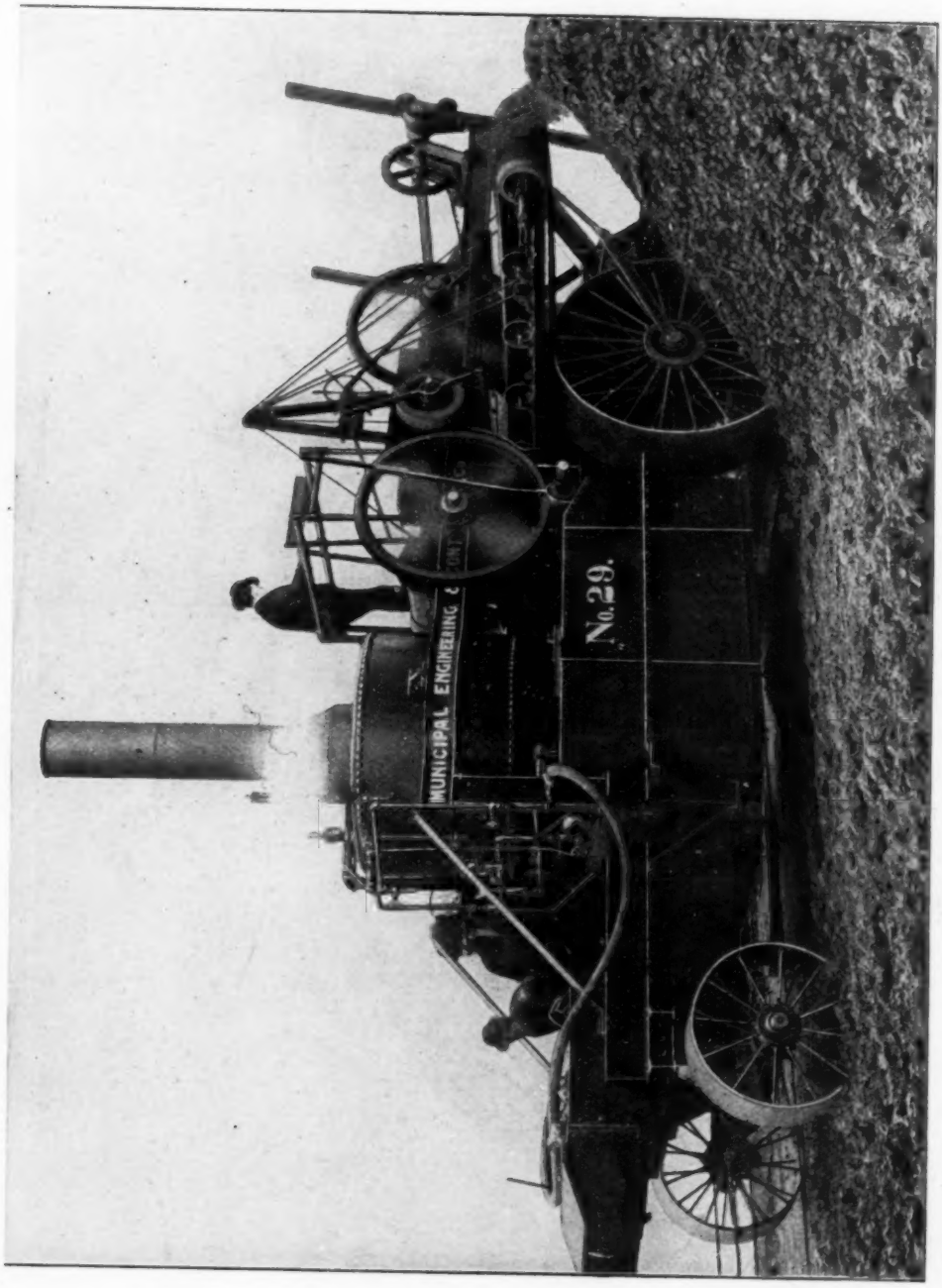
No More Sewer Digging by Hand

Great Machine Now Moves Along the Street and Plows a Furrow 20 Feet Deep

Digging a trench 20 feet deep and 5 feet wide at one operation, mechanically piling the dirt along the side of the trench ready for use in refilling, and rolling itself along over the route of the excavation as it works, a new excavator which has made its appearance in Chicago, entirely does away with the old method of digging sewers by hand. The laborers' part in the process is merely to pile the dirt back in the trench after it is dug. The machine does the rest.



Sewer Trenching Machine at Work



Side View of Continuous Excavator for Deep Trench Work

A pair of great endless chains carrying scrapers the width of the trench are operated by the engine. On these scrapers are carried small plows or scarifiers which tear up the earth beyond that picked up by the scrapers, thus loosening the earth for the plunge of the next scraper. An apron runs from the ground surface up to the point of discharge on the machine platform. At right angles to the scraper travel, runs a carrier belt on which the earth is dumped and by which it is carried to the side of the trench and deposited in a pile ready to be returned to the trench when the sewer is laid. When the trench is 20 feet deep the excavator frame stands nearly vertical, and when of less depth it is set at such an angle as to take out the earth at the desired depth. The width of the cut can be varied at will and the change in depth is made in a few seconds.

The machine is set on wheels and carries the necessary engine and boiler for operating the machinery. It moves forward automatically by means of a drum on which winds a wire rope attached to a post ahead and to the front of the machine. The excavator will dig a trench 120 feet long and 20 feet deep in one day. The cut is clean and absolutely straight. The machine is called the "Chicago Excavator."

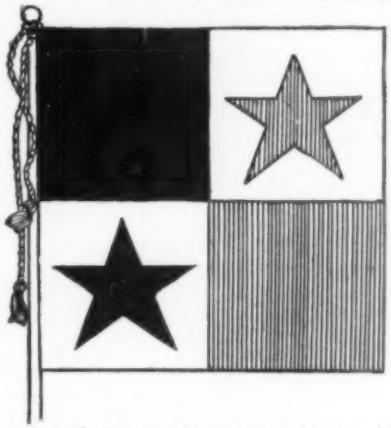
TRANS-CANADA RAILWAY SCHEMES.

Canada has outgrown its railroad facilities and vast resources of that county now lie dormant awaiting capital and enterprise for building a transcontinental railway. Canadian capital seems to consider the enterprise too gigantic and so American capital will come to the rescue. Americans are interested in the proposed construction of three railways across Canada. Two of them will probably be built. The Canadian Northern Railroad is building toward the Yellow Head Pass across the park lands of the Saskatchewan. The Grand Trunk Pacific will undoubtedly build from Moncton to Port Simpson. The Canadian government has granted a charter to the Trans-Canada Railway Company. The latter road, because of its importance from a military standpoint, has attracted wide attention. The proposed route is most direct, starting from Chicoutimi, the head of navigation on the Skaguay river, and traversing the newly discovered wheat and timber lands in northern Quebec. This road, if built, will open up the James and Hudson Bay territory to trade, make possible the development of mineral territory in northern Ontario, and will reach the wheat fields of Peace River Valley, and crossing the mountains at an elevation of only 2,000 feet, will end at one of the finest Pacific coast ports.

REPUBLIC OF PANAMA FLAG.

The first upper square, to the left, is blue; the first lower square, to the left, is white, with a blue star in the center.

FLAG OF THE NEW REPUBLIC OF PANAMA.



The second upper square is white, with a red star in its center, and the second lower square is red.

WORLD'S SHIPPING LOSSES LAST YEAR.

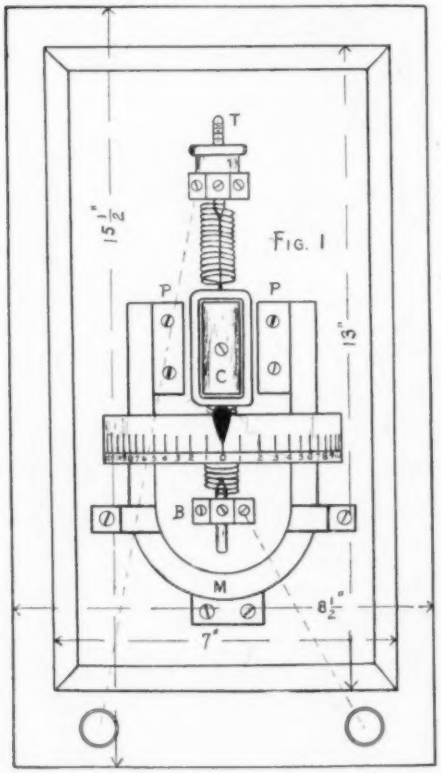
Lloyd's Register, in a statistical summary of vessels totally lost, condemned, etc., just published, shows that during 1902 the gross reduction in the effective mercantile marine of the world amounted to 872 vessels of 700,690 tons, excluding all vessels of less than 100 tons. Of this total 301 vessels of 408,363 tons were steamers, and 571 of 292,327 tons were sailing vessels. As regards steamers the present return exceeds the average of the previous eleven years by 21 vessels and 46,396 tons; as regards sailing vessels it is below the average by 204 vessels and 67,716 tons. The figures relating to steam and sailing tonnage owned in the United Kingdom are below the average by 40,863 and 30,908 tons respectively. Apart from vessels broken up, condemned, etc., the United Kingdom steam tonnage lost during 1902 is below the average of the preceding eleven years by about 48,000 tons, while the tonnage owned has increased during that period by nearly 4,750,000 tons, or 56 per cent.

EASY ELECTRICAL EXPERIMENTS

HOW TO MAKE A SENSITIVE GALVANOMETER.

A sensitive and well made galvanometer may be used for a variety of purposes. Not only may it be used for the testing of resistances, both high and low, but by the use of a proper shunt may be used to measure strong currents, and by the use of a high series resistance may be used to measure the voltage of an electric circuit.

An old telephone generator furnishes excellent magnets for the construction of such a galvanometer. A magnet which the writer has secured from such a source measures six inches in length and is made of steel, which is ½ inch by ⅝ inch. The more powerful the magnet the better. Its dimensions may vary somewhat from the one used in the following paper, but the reader can easily modify his instrument to suit his needs.



A bottomless box with a glass top will be required, mounted upon a base board, the whole being suited to be screwed to the wall, as shown in Fig. 1. This box is 7 inches by 13 inches outside measurement, and 4½ inches deep. The base board should be 15½ inches by 8½ inches. The box is secured to the base board by two hasps, one on each side, two or three dowel pins helping to hold the box from slipping. This method of securing the box is adopted so that the case may be easily removed, giving access to the working parts of the instrument inside.

The magnet used being ⅝ inch wide, two pieces of iron, shown at P, are made for pole pieces. These are ⅝ inch square and 1⅞ inches long, and have bored through them two holes ⅛ inch in diameter, through which are to pass screws to secure them in place. Secure the magnet firmly to the base board, its poles being 9¼ inches from the bottom, and at equal distances each side of the center line. A block of wood at each side of the magnet, another at the bottom, and two clamps, one at each side, ought to secure the magnet firmly in place so that it cannot slip. Then screw the pole pieces into place, taking care that they rest firmly against the inner poles of the magnet. This will leave 1 7-16 in. of clear space between the poles, if the dimensions given have been followed. If the magnet used has dimensions differing from those given at M, Fig. 2, allowance will have to be made in the pole pieces, so as to leave the proper space between the pole pieces.

In the exact center of this space is to be secured an iron cylinder, shown in Fig. 1, and also at C in Fig. 2. This is 1⅞ inches long and ¾ inch in diameter. It is to be fastened to the base board by a screw passing completely through it. This should leave a clear space of 1-32 inch on each side of the cylinder.

It is well at this point to take a very small sharp chisel and cut two grooves in the base board, these grooves being extensions backward of the spaces between the poles and the cylinder on each side. These grooves are necessary, in order to allow the coil shown in Fig. 1 to swing freely in either direction without striking the back board.

Take next a piece of the thinnest copper procurable. It should be very thin in order to be light and to take up as little space as possible. From this sheet copper make a frame such as is shown at F, Fig. 2. It is

rectangular in shade and measures 2 inches by ⅞ inch inside, and 2½ inches by 1⅜ inches outside. Its width is ¼ inch. As shown in the side view at K, it is a frame with the edges bent up so as to form a deep groove running around the face of the frame for holding a coil of fine wire. Where the frame overlaps it must be neatly soldered. At the corners the turned-up edges will be cut away, but this will do no harm. Line the slot in this frame with a layer of thin but tough paper, fastened in place by shellac. This serves to insulate the frame. Then wind the slot full of No. 36 single silk covered magnet wire.

The ends of this coil are left projecting, one at each end. Shellac the outer surface of the coil and set it aside to dry.

Now make two little pieces shown at E, Fig. 2. They are made by taking a piece of thin copper, ¼ inch by ⅜ inch, and soldering to its center a projecting wire of stiff brass, ¼ inch long. Flatten the outer end of the brass wire and drill a small hole through the flattened part. These little pieces are then bound on to the ends of the coil by silk threads, so that the projecting wires form a spindle about which the coil may rotate. For this reason they must be so adjusted as to project from the exact center of each end. Also care must be taken, in bending them on, to insulate them from the coils by slipping a piece of thin paper under them. Then the projecting ends of the coil are soldered to these little strips, one at each end, and the superfluous wire cut off.

Two pieces of brass should be made like those shown at B, and also at H, Fig. 2. As shown in Fig. 1, these are to support the coil in position. The hole through B, therefore, should be ⅜ inch from the back side of the piece, and H should slide freely through B, but may be secured by a set screw. One of the pieces shown at H should be threaded and provided with a thumb nut, as shown at T, Fig. 1. One end of H should be flattened and drilled as were the ends of the projecting wires on the coil.

Now procure some fine silk fibers, preferably of raw silk, and pass one end of the fiber through the hole in the upper wire spindle of the coil, securing it firmly by a drop of sealing wax. In a like manner secure a fiber to the lower spindle. Then, with T in place, Fig. 1, pass the fiber through the hole in T, pull it up until it is of the right length, and fasten with sealing wax. Do the same at the bottom, and the coil will be suspended so as to swing freely in the space between the cylinder and the poles.

Current is led into and out of the coil by two very small slender springs shown at the top and bottom. They are made from No. 36 (no finer) German silver wire,

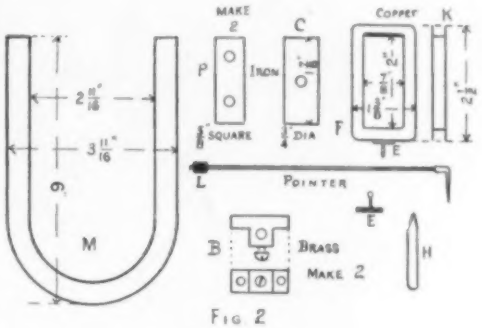


FIG. 2

coiled around a small pencil so as to make a very weak spring. By carefully removing T, and leaving the fiber slack, the ends of this coil may be soldered to T and to the pivots of the coil. This process should be repeated at the bottom.

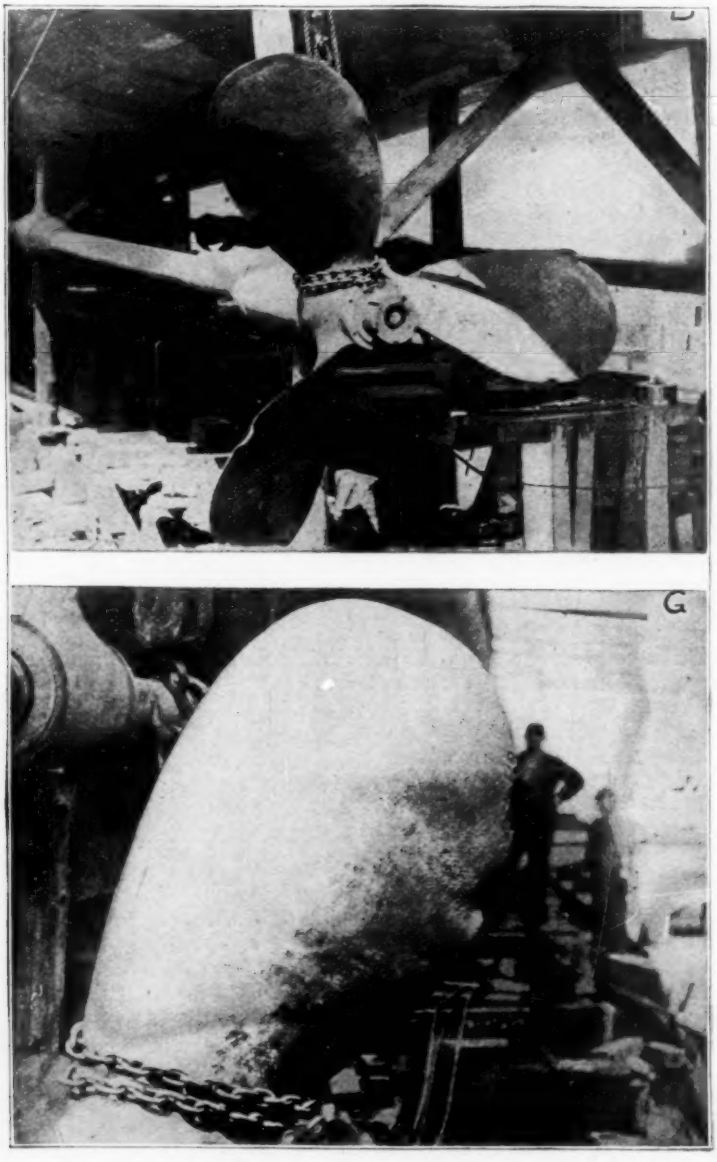
At S is a circular scale, made of a piece of white bristol board. It projects forward from the instrument, and is bent so as to have the axis of the coil for a center. The radius of the arc of this circle is 2½ inches. A pointer shown in Fig. 2 is glued to the bottom of the coil, and its front end moves over the card board scale. This pointer is made by taking a strand from a broom, and fitting a thin piece of copper at its outer end to serve as an indicator. The back end of the pointer projects beyond the coil, and is counterweighted with a small piece of lead, as shown at L.

Thus the silk fibers serve to suspend the coil in place, so that it may swing freely, while the coiled springs encircling the fiber carry the current into and out of the coil, and also serve to bring the needle to zero after being deflected.

Binding posts at the bottom are connected to the upper and lower suspensions as shown.

If the amateur is skillful he can improve the instrument by using two very fine hair springs in place of the coiled German silver springs. These may be secured at a watchmaker's, and besides being more reliable are not so stiff as the German silver springs, and therefore render the instrument more sensitive.

Disastrous Results of Supposed Torsional Vibrations



Propeller Blades of the United States Torpedo Boat Stringham.

Strange Vibrations on Torpedo Boats

Effects on Propeller Blades Leads to Theory of Torsional Motion

By Admiral George W. Melville, Chief of the Bureau of Steam Engineering, United States Navy

It has been frequently found in United States torpedo boats that after running for a time a notch forms about two-thirds of the radius out from the center on each blade of the propeller. Many fanciful explanations of this have been offered, and Macalpine guesses that it is due to torsional vibration. It is shown clearly in the illustrations, (page 338) from photographs of the United States torpedo boat Stringham. The vibration is more or less like the crack of a whip. If we conceive a blade with no pitch, this vibratory action would alternately put a strong compression and extension on both leading and following edges of the blade. The resistance of the water, on the other hand, would put a tension on the leading edge and a strong compression on the following edge. Thus, if the effect were strong enough, the leading edge would be stretched, while the following edge would be compressed; and if it tapered off sharply enough, the bronze would buckle as shown. Now, in an actual blade this buckling action could not happen near the root, as the acting forces would bend it about the long axis of the root section; but when we get out to where the notching actually occurs we have a case not dissimilar to that of the blade with no pitch. The notching always occurs on the after edge, as this explanation demands; and the bulge seems always to be aft, as the picture shows, and seems most probable from the supposed action.

When the Stringham was docked it was found that a large area on the aftermost, commonly called the "go-ahead," face of the blades, extending nearly half-way across the blade from the outer half or two-thirds of the leading edge, was scoured bright, while the rest of the face was dull and overgrown with sea grass. This is not well brought out by the photographs. A similar effect was shown on the other, or "go-astern," face of the blades, but the bright part was near the following edge. The bright parts are exactly where we would expect the greatest scour. By the time the water got well across the after side of the blade there would be a layer of sensible thickness which had little motion relative to the surface of the blade, thus mitigating the scouring action. On the forward surface cavitations or strong eddying would be sure to produce a powerful scour near the following edge.

I reserve my judgment, but if this is the true cause it shows that severe torsional vibration is uncommon.

MANY CHANGES IN COLOMBIA.

The United States in its attitude toward the Panama revolution was governed in the main by the treaty which this country signed Dec. 12, 1846, with the Republic of New Granada. This treaty grants to citizens of the United States as full and complete commercial privileges in all parts of the territory, including Panama, as its own citizens enjoy. The Republic of New Granada was succeeded in 1858 by the Granada Confederation. This gave way in 1861 to the United States of New Granada. The United States of Colombia followed in 1863, which in turn was replaced in 1886 by the present Republic of Colombia.

The Canadian parliament is being urged to send an expedition in search of the North Pole. The ambition is founded on her claim to all territory north of Canada.

SLEDS WHERE THERE IS NO SNOW.

In the City of Madeira, where no snow ever falls, the typical vehicle is a sled. It is called a "carro," and is pulled by oxen.

"Carro" the Queerest of Vehicles

The "carro" driver acts as a guide to tourists and his services are quite indispensable.

CONCRETE PILES DRIVEN INTO GROUND WITH PILE DRIVER.

Centralblatt der Bauverwaltung, of Berlin, says: An interesting departure in building engineering is made in the construction of the new Berlin-Wedding law courts, particularly in the laying of the foundations. The unstable nature of the ground necessitated some system of foundation that could be relied upon to give adequate support to the vast edifice. After serious consideration and exhaustive experiments with various systems, strengthened concrete piles of triangular section with cut-off corners were decided upon. These consist of hard gravel and best Portland in the proportion of three parts of river ballast to one of Portland, and varying in length from 17 to 26 feet. The strengthening consists of three ¼-inch-thick iron rods with blunted lower ends and connected at 10-inch intervals by T rods. Carefully mixed in a pug mill, the slightly wetted concrete is spread in vertical wooden moulds in 8-inch layers and compressed to four inches. To insure uniformity of incorporation the surface of each preceding layer is roughened previous to adding fresh doses of concrete and fixing the T pieces. The completed pile is then left to itself for twelve to twenty-four hours and constantly and abundantly moistened during the succeeding seven or eight days, after which they are removed from the moulds and again watered for the next eight or ten days. By then the piles have sufficiently hardened to admit of transport, and in another ten or twelve days are ready for use. In this instance the piles were driven into the ground with the aid of a steam pile driver, with a 2½-ton ram allowed a fall of 5 feet 6 inches. To prevent damage to the heads of the piles, cushions consisting of sheets of lead and iron and timber packing held together by an iron band were interposed.

ANOTHER NON-PUNCTURABLE TIRE.

George W. Sweeney, of New York, thinks he has invented a non-puncturable tire for automobiles. The tire has a metallic rim into which is placed a soft rubber tread and outer wire. This has on its outer side a ring which presses down into the inner side.

New Rubber Tire

ODD CUSTOMS OF THE CHUCKEE ON THE TRANS SIBERIAN RAILROAD.

The completion of the Trans-Siberian Railroad has revealed to civilization some queer peoples and customs. One of the oddest of these heretofore secluded races are the Chuckee, who, it is said, originally came from the tropical shores of the Bosphorus.

Scene at a Chuckee Burial Service

Most peculiar of the peculiar customs of the Chuckee is their burial service. The relatives feed a last meal to the deceased and go through a weird divination performance. The corpse is then tied lengthwise on a reindeer sledge. When the destination is reached the reindeer is killed. The clothes are cut from the body of the corpse and for every piece is exchanged a slice of reindeer flesh until the body is entirely covered. It is then left exposed to the ravages of the wolves and foxes, and the sooner it is consumed the better it is supposed to be for those living.

PRIZES FOR NEW STEAM PLOWS.

The British Export Gazette says: "If the fertile lands of Rhodesia are to be adequately cultivated the old-world methods of plowing will have to be superseded by something. Recognizing this fact the directors of the British South African Company have decided to make a departure which will be of interest to makers of mechanically driven plows. They propose offering £2,000 ($10,000) in prizes for the best steam cultivators forwarded for the competition trials which will be held next year in Rhodesia. This is a unique opportunity for British makers of this class of implements to introduce their specialties to the South African public. The contest will doubtless be thrown open to the world, and thus has the added zest of emulation to its commercial aspects. The results will have a lasting effect on the course of future trade in these lines with the subcontinent, and consequently British firms would do well not to neglect the chance this opportunity gives them.

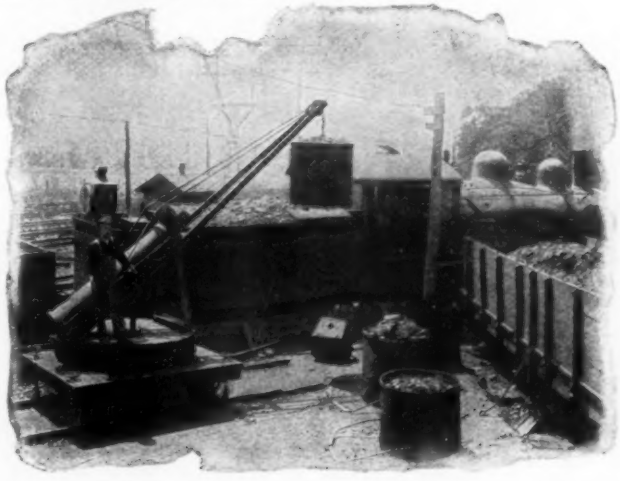
Lifts Great Weights by Compressed Air

Loading and Unloading Made Simple and Expeditious by the Pneumatic Crane

The pneumatic crane strikes one of the hardest of the many modern blows to manual labor. Loading and unloading cars is made simple and speedy by this new compressed air machine, and two men are all that is required for the heaviest work; but these two men with the aid of the crane can unload the car quicker than could a dozen men by hand. The cranes are built of various capacities, some to lift weights of 50,000 pounds. They serve in loading and unloading materials of almost every description.

In coaling locomotives they have worked a most notable change in former methods that is far reaching in its effects. The cranes for this work are made of about 3,000 pounds capacity. They have a reach of 12 feet, hook lift of 12 feet 6 inches, and height from rail to top of boom, 18 feet, which is necessary to give sufficient height for lifting drop-bottom buckets high enough to clear the top of the coal or locomotive tender. The crane is supplied by air direct from the train pipe, connection being made at the back of the tender, thus making it unnecessary to maintain a compressed air plant at the coaling station. It is usual to have ten or twelve 1-ton drop-bottom buckets filled direct from the coal car and placed within reach of the crane thus making it possible to load the tender very quickly with the train crew.

Stationary Pneumatic Crane Unloading Car Trucks



Three Thousand Pound Garry Crane Coaling a Locomotive

A 4,000-pound revolving pneumatic crane mounted on a turn table and hand truck is used on the Lake Shore & Michigan Southern railroad for loading and unloading cars and in handling material generally in and about their Collinwood shops.

Pneumatic Crane. Mounted on Car, Loading Timbers

The pneumatic crane mounted on a car, shown in the illustrations is used for loading and piling buffer beams. It is also convenient for loading car sills and other heavy timbers, locomotive wheel centers, car wheels, axles, tires and heavy castings.

The stationary pneumatic crane is of great service to a freight repair shop or yard equipment in loading and unloading freight and passenger car trucks from cars.

These cranes are also built to be operated by steam.

FRENCH SHIPPERS IN WRATH.

Journal de la Marine, of Paris, says: French charterers of sailing ships are up in arms against the charge of French insurers. The rate is from 30 to 35 per cent above that charged by English offices to English charterers. Finding out what French insurers charged, the English insurers are now charging French charterers at the same rate, and the situation is further aggravated by the higher cost of shipbuilding in France. A ship built in England for $90,000 and paying a premium of $5,400 would cost in France $140,000 and have to pay a premium of $11,500. The difference in favor of the English boat, therefore, is about $6,000 per voyage. Admitting that bounties are paid to French ships, still these bounties were intended to compensate French shippers for disadvantages they labor under compared with other nations—they are different from extra insurance charges and therefore will not enable French shippers to compete successfully with other nations so long as the matter of insurance charges is not righted.

Four Thousand Pound Revolving Pneumatic Crane, Mounted on Turntable and Hand Truck, Used for Handling General Material

Diamonds and fine specimens of corundum in the form of both rubies and sapphires have recently been found in the Republic of Liberia by a prospecting party sent out by the West African Gold Concessions Company.

South Dakota claims the largest cave in the world. It is Wind Cave at Hot Springs, extending 90 miles in different directions and containing 2,500 chambers.

Brick Houses Supplanting the Mexican Adobe Structures

President Diaz Gives Aid to the Americanization of His Country

Brick houses for Mexico, to succeed the old adobe structures, for generations the home of the poor, are to result from President Diaz's efforts to introduce American methods into his country. Brick, it is found, can be produced in Mexico at a wonderfully low figure. There is an abundance of material and labor is so cheap that the brick houses can be built almost as cheaply as the old fashioned dirt structures.

A Plantation Brick Yard

Brick yards are springing up in all parts of Mexico since President Diaz has admonished his people to abandon their old style of residence building. This will be one of the most important steps of improvement that Mexico's progressive president has ever taken. Brick making now promises to become one of Mexico's most important industries. Of course the very poorest of the brick made is to be used in the new houses of the poor, but a very superior product, equal to most of that manufactured in America, is now coming from the Mexican brickyards. This is nsed in the construction of the numerous business houses and residences of the American type that are to be found in increased numbers in all Mexican cities since the American invasion began.

Tropical Truth says: In Mexico, as in all the Latin-American countries, the old patriarchal fashion is still maintained in

President Diaz of Mexico

the home life. Often several generations live peaceably under one roof, constituting a most happy family. The elders are consulted on all important family matters and treated with reverential affection.

The advent of many strangers and the foreign commercial invasions have made many changes in Old Mexico. The whistle of the locomotive, which followed the daring American railroader in his long trail through the deserts of Northern Mexico to reach more fertile lands, has frightened the burro trains and awakened the nation from the sleep of centuries. The "diligencias" do not depart now from the patio of the Hotel Iturbide, and the historic bandits that held them up are gone to the long sleep.

WHY IT DOES NOT LIGHTNING IN WINTER.

Editor Popular Mechanics:—Will you please explain why we do not hear thunder and see lightning in winter.—Otto Glason, Medford, Miss.

Thunder is merely the sound accompanying the electrical discharge known as lightning. In most parts of this country such discharges do not occur in winter because the atmospheric conditions are not conducive thereto. Lightning occurs when warm moist ascending currents of atmosphere and cool dry descending currents come into close proximity. The stratum of air between these two approaching currents virtually "breaks" from the compression. Electrical action has been excited in the dry atmosphere above through the compression and the electricity escapes in the direction where there is least resistance. In other words the intervening stratum "breaks" where it is weakest and the path of the lightning is the "crack" where the "break" occurred. The sound of the "breaking" is called thunder.

There are places where lightning occurs in winter. In Northwestern Scotland thunderstorms are always in winter and at night. In Jerusalem where it is dry and rainless there is no lightning or thunder.

Benjamin Franklin says: "Where there is a great heat in the land in a particular region (the sun having shone on it perhaps for several days while the surrounding countries have been screened by clouds) the lower air is rarified and rises, the cooler dense air above it descends, and the clouds in the air meet from all sides and join over the heated place, and if some are electrified, others not, lightning and thunder succeed and showers fall."

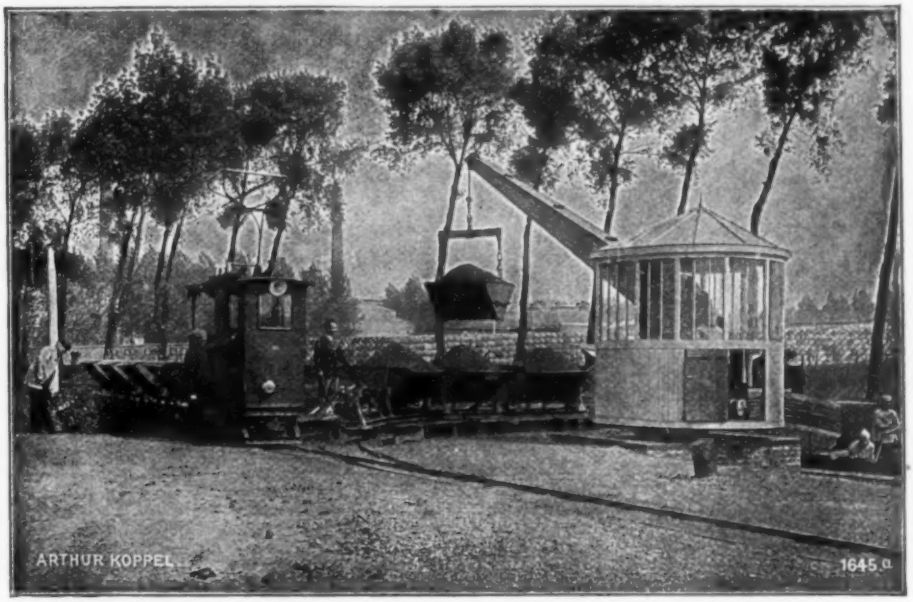
Another authority says: "The stratum of air between the descending dry air and the ascending hot, moist air, acts like the insulating glass plate between two metallic surfaces and when at last the attraction between the two opposite electricities becomes too strong for the interposed medium they rush together producing the disruptive discharge accompanied by the flash and report. With a good conductor passing from the cloud to the earth, the electrical equilibrium would be silently restored, as a Layden jar is quitely discharged by connecting its inner and outer surfaces with a wire pointed at each end. But if an imperfect conductor is interposed the electricity seeking to follow this may produce the most violent effects and these are exhibited at the points where the continuity of the conductor is imperfect or interrupted."

The more the air is rarified the more it will permit the passage of electrical current and the more it is compressed the more resistance it offers.

But 8.3 per cent of the German born males in the United States have failed to become naturalized, while 13 per cent of the English, 35 per cent of the Russians, 53 per cent of the Italians and 80 per cent of the Japanese are still aliens.

Some Queer Little Railroads

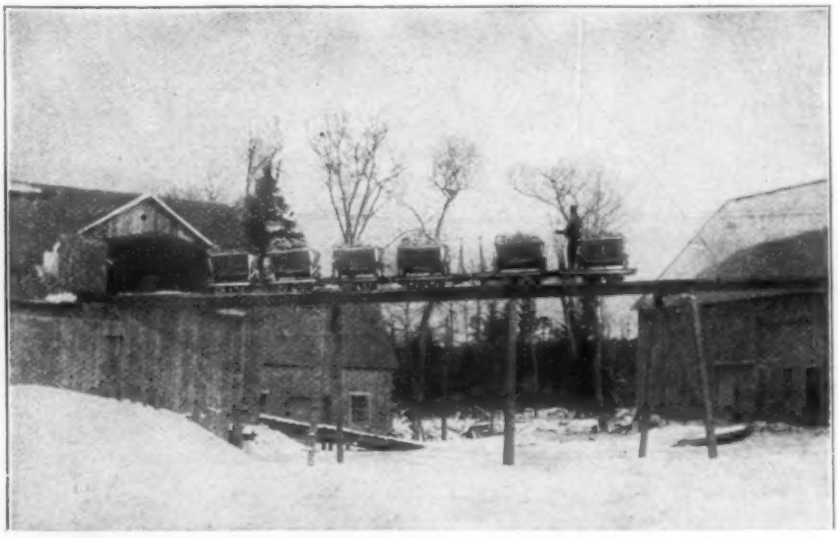
Many Lands Build Tracks for the Small Cars to Run On

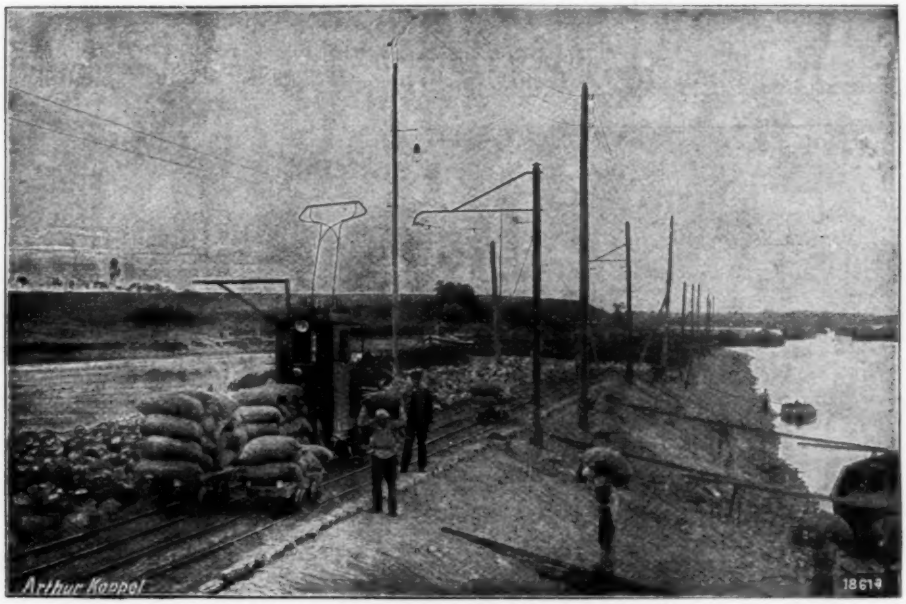


Complete Electric Coal Railway and Crane Equipment for Factory Use, in France.

Some queer railroads are appearing in different parts of the world to accommodate the odd-looking little cars, manufactured in America for use in mines, factories, etc., described in previous issues of Popular Mechanics. One manufacturer of these cars noting the article in Popular Mechanics sends some very interesting photographs,

Tracks and Cars for a Canadian Copper Mine.





Electric Factory Railway, Used in a Sugar Refinery.

from which the accompanying illustrations are made. It will be noted that the cars are used in copper mines, on elevated and surface roads, in the hauling of coal, for railway construction, in the service of contractors and builders, in sugar refineries, etc. These pictures give but a small idea, however, of their general employment in nearly all commercial capacities, as previously related in this magazine.

Portable Electric Railway Equipment, Complete for Contractor's Use.

The Submarine's Successor

"Submergible" Appears in France and Reveals Many Important Advantages

"Le Petit Journal" of Paris says: "The submergible boat has met with great success in France and is preferred to the submarine. Submarines, having the supply of electricity stored in accumulators, cannot cover more than fifty miles without having their accumulators refilled. For this reason they cannot go far from the naval port which serves as their base unless they are sure of finding a supply of electric power in a factory on the sea coast or on board a vessel provided with a special electric plant. The submarine, even when traveling above water, cannot attain a speed of more than eight and one-half miles an hour.

"In order to remove these drawbacks it was necessary to design a boat capable of traveling for a considerable distance from the coast and able to remain there long enough to lie in wait for the foe and thus insure the success of an ambush. In this way there arose the idea of the submergible boat. Having a higher tonnage (200 tons instead of 68), and being almost twice as long (46 yards instead of 25), the submergible boat can cover a much greater distance than the submarine. It carries a boiler heated with petroleum, and this allows it to sail above water like an ordinary boat and to attain a speed of from 12½ to 13½ miles per hour. It is provided with fuel enough to cover 304 miles at this speed, or 717 miles at 6 miles an hour. Submergible boats carry, in addition, as is the case with submarines, an electric motor for traveling under water, and the electricity is supplied from accumulators, but with the immense advantage that the latter can be recharged by the steam engine on board either when the submergible is above water or when it is stationary. When under water submergible boats can cover, without having their accumulators recharged, 28½ miles at the maximum speed of 9 miles an hour. It is therefore obvious that submergible boats are far superior to submarines, if only owing to the fact that they have a more extensive range of action. It is true that they submerge less quickly—the submarine can disappear in two or three minutes, while the submergible, even with a well-trained crew, must reckon on seven minutes to effect its disappearance. This inferiority, however, is of small account in any case, and was not very apparent in the maneuvers executed by two submergibles from Cherbourg against the large transatlantic mail boats, Champagne and Bretagne, in the open sea."

WOULD FOUND AN EMPIRE IN SAHARA.

To found an empire in the Desert of Sahara is the project of M. Jaques Lebaudy, a millionaire Frenchman, termed "the Empire of Sahara." France has denied his appeals for protection in the enterprise. Paris calls him crazy. England thinks his scheme feasible but has denied him aid, fearing a misunderstanding with France. Lebaudy claims to have discovered an oasis in

M. Jacques Lebaudy, the "Emperor of Sahara."

Sahara, verdant and well watered, as large as Ireland. The photograph here reproduced was taken by a Popular Mechanics representative while Lebaudy was leaving a building in London.

While flying a monster box kite, 12 feet high by 4 feet square, Edgar Merritt of Glenwood, Ia., was jerked from the ground and carried high in the air. He turned to earth again by sliding down the kite rope.

FRENCH FLORAL CLOCK.

Paris has a wonderful floral clock, the dial 100 feet in diameter and the figures made in blooming plants. The Keystone says: This clock, the dial plate, figures and ornaments of which are composed entirely of flowers, is located in the garden of the Trocadero, in Paris. The dial plate, the work of a Paris gardener, is a mosaic of flowers. The movement is the work of M. Casalonga. The clock has a striking apparatus, which strikes the half hours and hours. The clock works are in the little tower to the right of the dial plate on the above picture

A STUDY IN BARNACLES.

When the great German warship "Kaiser Friedrich," went into dry dock at Kiel after a long voyage recently, it was discovered that Neptune had adorned her helm, screw

"Kaiser Friedrich" in Dry Dock, Showing Queer Adornment with Barnacles

and bottom with a queer disguise. Barnacles were everywhere giving the appearance from a distance of vines clinging to the vessel.

PRODUCE NITRIC ACID FROM AIR BY ELECTRICITY.

The Societe Internationale des Electritions of Paris is greatly interested in a paper submitted by M. de Kowalski describing some results obtained in producing nitric acid from the air by electrical means. The reaction is brought about by "sparking air" as in the old Cavendish experiment. The potential used was 50,000 volts and the frequency varied in different experiments from 6,000 to 10,000 alternations per second. The best result obtained when using air only was 1.94 ounces of nitric acid per kilowatt-hour, but by adding oxygen to the air this figure was substantially improved.

SPEED OF AUTOMOBILES.

What is considered a safe rate of speed for an automobile seems to depend very largely on whether one is riding in the vehicle or trying to escape being run over while crossing a street. Naturally the operators have numerous arguments in favor of speeding along the street like a race horse.

In France so much interest is had in the sport, that the French Parliament appointed a committee to look into the subject and from its report the following is gleaned:

Comparison is made with the bicycle, of which more than one million are in use in France. At first people were frightened at their speed; now no comment is occasioned as they dart here and there, in all parts of the country. What now seems a fast speed in automobiles may not appear so a few years hence. The machines are considered more easily to be managed than horses.

Building automobiles constitutes the first new really flourishing industry that has been built up in France in many years. In 1902 exports amounted to $6,000,000, and for 1903 will reach $12,000,000. Employment is given to 180,000 workmen.

Owing to improved brakes a speed in the country of 37 miles an hour is now considered safer than 18 miles five years ago. In cities 12 miles an hour is considered about right.

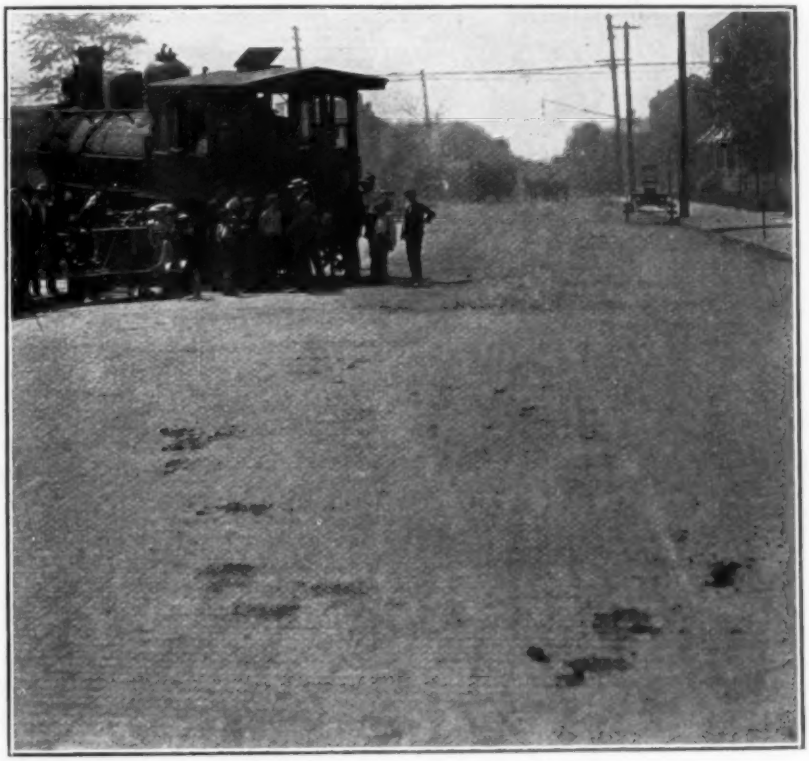
The great salt deposists of the Grand Chateau, a group of islands off the Louisiana coast, which have hitherto defied all efforts to mine them, because of the deep strata of quicksand, are now being successfully operated by the Standard Oil Co.

Runaway Locomotive Tears Through Streets

Leaves Its Track at an Indianapolis Crossing and Takes to the Center of Senate Avenue

People of Indianapolis were nonplussed the other day to see a big switch engine come tearing down the middle of Senate avenue with a lot of railroad men running after it. The engine had left the railroad track at the crossing and taking to the center of the paved street, crossed several railroad tracks and ran nearly a block before it curved to the side of the street and stopped against the curbing. Some one had pulled the throttle of the engine while the engineer and fireman were at lunch. What is most remarkable about the occurrence is that the brick pavement was practically uninjured by the great weight of the locomotive. The engine had three pairs of driving wheels. The light line in the photograph shows the sand which ran from the engine's sand box.

The ability of brick pavement to withstand wear and hard service is pointed out by Municipal Engineering in describing the occurrence.



Runaway Locomotive After It Had Finished Its Mad Run Through Senate Avenue, Indianapolis.—Courtesy Municipal Engineering

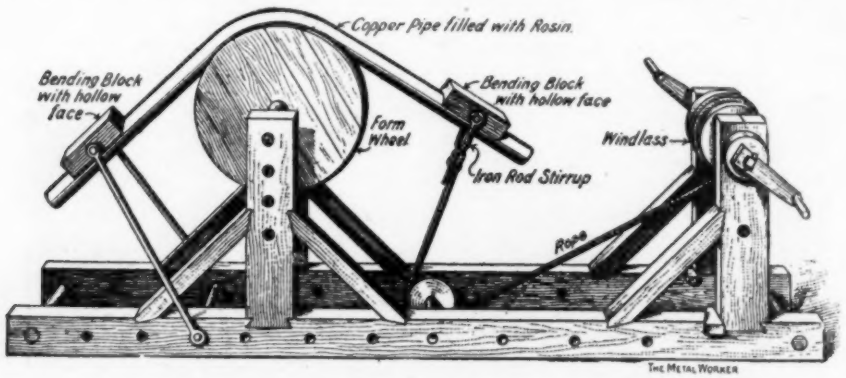
WORLD'S LARGEST LIFT LOCK.

The great lift lock in the Trenton canal, near Petersboro, Canada, which has just been completed, is the largest lift lock in the world. Canada is making extraordinary efforts in the improvement of its natural and artificial waterways. To facilitate traffic through the Welland canal that waterway is to be illuminated by electricity from end to end. A 14-foot waterway is to be provided in the Galoups canal around the St. Lawrence rapids. The government has awarded a big contract for the dredging of the western approach to the Canadian Soo canal.

SHOP NOTES

HOW TO BEND COPPER PIPE.

I have seen copper pipe from 1½ to 6 inch for distillery purposes, bent over improvised apparatus of various kinds, but nowhere have I seen the means of bending illustrated, says a writer in the Metal Worker. The sketch shows the essential features of a machine rigged up by the shop carpenter for a coppersmith, in the heart of one of the distillery districts of Kentucky. While not ideal, it combined some of the good points of several makeshifts which the smith had rigged on different jobs when time was limited and work too pressing to wait for something better.



Bending Copper Pipe

As I remember it, the frame work was 6 by 10 inch stuff, 20 feet long, with windlass and form wheel posts of same, and braces 6 by 4 inch, set at an angle of 45 degrees. There were holes along the frame on both sides, so that the rods from the rear hollow block could be attached by slipping the bolt through near the form wheel posts, or further back, according to the degree of bend or its position. The snatch wheel shaft under the forward block was movable in the same way for the same purpose. There were holes in the form wheel posts, so that the wheel could be lowered or raised. There were several form wheels of different diameters for different size bends, some with V-shaped groove to encourage wrinkling; others with circular groove, used according to the size and thickness of pipe and radius of the bend. Many sizes of bends and offsets on different sizes of pipe were made with one form wheel. There were many hollow blocks, some long, some short, all of the same width, so that the same stirrup and bolts would work on them. All the blocks for small pipe, 2 to 4 inch, were made of wood pump tubing, sawed through the base and built out for the stirrups. The windlass was wood, with two handles. Small pipe was bent by using the windlass direct, as shown in the sketch. Large pipe was bent by putting sheave blocks between the snatch wheel and the windlass, one block being attached to the pull rope and the other to a rod between the windlass posts, the block rope being wound on the windlass. Some skill in shifting the hollow blocks, rods and the pipe on the form wheel is essential to good and rapid work. Any means to the end is admissible, to make the bend as required being the object, and common sense to the point of "melting out," malletting up and refilling being in order.

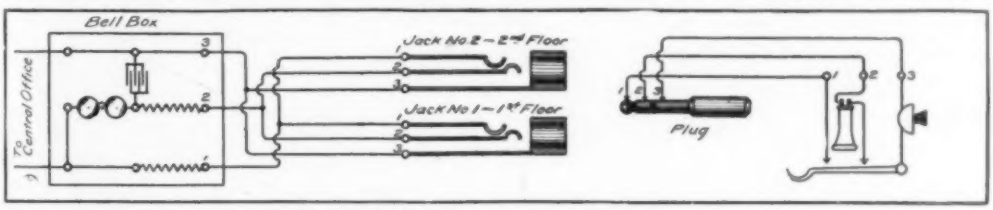
Seamless drawn hard pipe requires annealing by heating red along where the bend is to be made. The balance can be left hard to help resist the strain of bending. Hand made pipe from brazier's copper is soft, and no effort was made to further anneal it. When bending brazed pipe the seam is placed about midway between the neck and the side of the bend. Brazed pipe often requires hollow blocking all along the part subject to strain to make it bend only at the particular place if the ends must be straight. If a worm is being made, some permanent strain between the

block and form wheel is of no consequence, since that part, too, will be reached and bent more in the same direction.

Sand packs too much to be of real service in bending copper pipe. Lead or rosin is nearly always used, and rosin principally—it is light and serves the purpose. The lengths are closed at one end, stood upright and filled by pouring in the rosin, melted, until full. After bending the rosin is melted out at the forge, beginning to heat the pipe at the end.

HOW TO USE ONE TELEPHONE IN TWO PLACES.

The desk set telephone is found in many residences. Often the subscriber likes to use the phone down stairs during the day, but would find it convenient to have it in his bedroom at night. To avoid the expense of two phones, the following description and diagram from the American Telephone Journal will explain the arrangement of the wires: Place the bell box in a convenient place where it can be heard all over the house. Then run three (3) wires from posts 1, 2 and 3 on the bell box to points 1, 2 and 3 at the jack No. 1 down stairs, and run three wires to jack No. 2 on the second floor, which can be in the bedroom, and then by connecting 1, 2 and 3 points of the cord on the stand set of instrument to plug points 1, 2 and 3, the telephone can be used in either place by inserting the plug in the proper jack. The bell will ring for the subscriber whether the plug is in the jack or not. The arrangement is for a common battery station only.



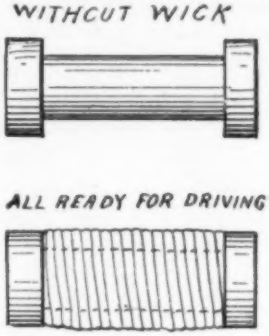
To Make One Telephone Serve Two Departments

STOPPING A LEAK IN A BOILER.

All engineers know what trouble it is to get an old tube out of a boiler. It is no trouble to put in a new tube if you can get the old one out.

Now I want to tell how I stopped a leak in a tube about six feet from one end, says a writer in the American Miller. The tube is 3 inches in diameter. I took a 2-inch gas pipe, about 8 inches long, put a narrow coupling on each end, wrapped asbestos wick around the middle and drove it into place with a 1-inch gas pipe.

This beats plugging all to pieces, as you still have a draught through the 2-inch hole. The pressure forces the wick up against the coupling at each end and there is no inclination to blow the plug out. A short piece, 2 or 3 inches long, would do for a leak at the end of the flue. The drawing shows the plug with and without wick.



Arrangement to Stop Leak in Boiler Tube

TO BECOME A SUCCESSFUL MACHINIST.

A young man who was about to start in to learn the trade of a machinist, received the following good advice from an old man who had built up a large fortune, starting with nothing but his own efforts. The counsel applies equally well to any undertaking. He said: "Young man, if you see a piece of work on the floor that has to be lifted and it takes more than one man to lift it, always be the first to take hold of it, don't let *anybody* get ahead of you; if you follow the spirit of this advice for four years you will come out a good mechanic."

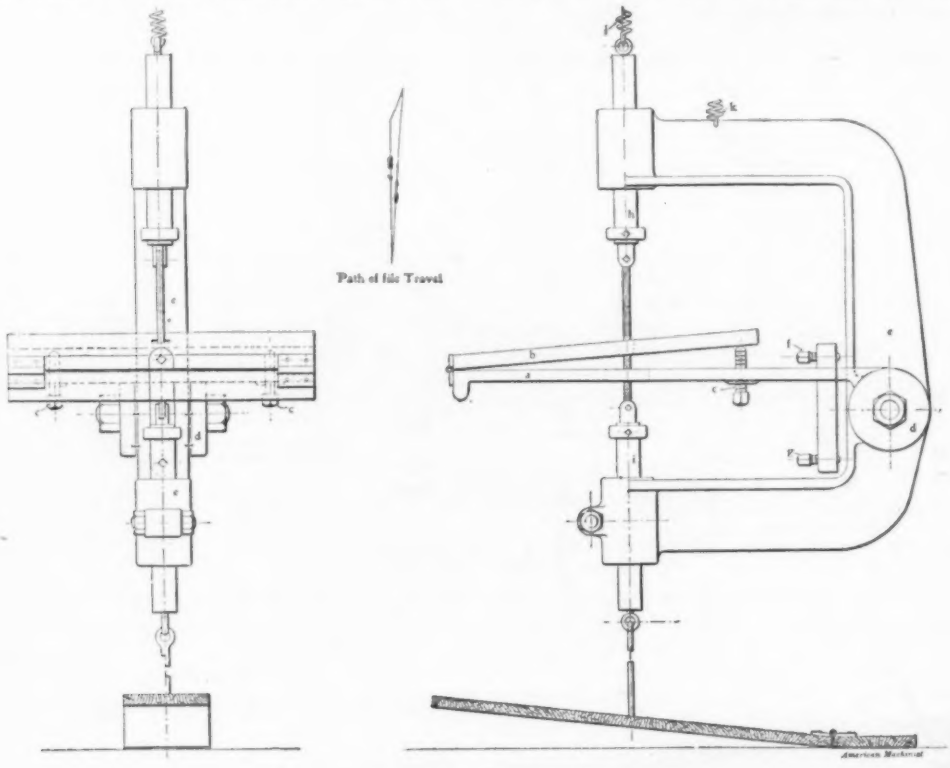
The catalog of the Hoffman Motor Works, 1253 North Halsted street, Chicago, will interest those desiring to build a motor bicycle, automobile or launch.

FOOT POWER FILING MACHINE.

This is a home made machine, which has never been put on the market, nor is there any patent on the device. The American Machinist, from which the following is condensed, says the operator has full control of the machine and has his hands both free to guide the work:

The machine is arranged to be placed on a bench, or stand, preferably with a side light, in order the better to see the lines to be worked to. It consists of a platform or top-plate a, supported by legs or other convenient means, and provided with a hinged leaf b covering the top portion immediately surrounding the file and serving as a work supporting table; this leaf is capable of being tilted at an angle for the purpose of obtaining clearance in the dies, and has a pair of screws c for adjusting and holding it in position. From the back of the platform depends a pair of lugs d having wide interior faces, between which is fitted a boss on the file holding frame e; a turned bolt passes through the parts and forms a fulcrum pin on which the file frame is free to swing. The amount of swinging action is limited, however, by the screws f and g, only enough being allowed to permit the file to clear the work on its upward stroke; it is evident that if both screws were set up, no swinging action could take place and the motion of the file would be perpendicular in both directions of its travel and during its entire stroke.

The front ends of the U-shaped file frame have bosses bored in alignment to each other and provided with neatly fitting plungers h and i; the lower boss is split and has a clamping screw to take up the wear and also to maintain sufficient tension on the plunger to cause the frame to move with it as far as the limiting screws will permit. Both plungers are provided with suitable clamps at their inner ends to hold files, and at the outer ends with hooks or loops for attaching, respectively, a spring at the top and a strap or rod at the bottom; they also have adjustable collars on them to limit their movement and the stroke of the file. The spring j, at the upper end, has sufficient tension to draw both plungers and their attached parts up until



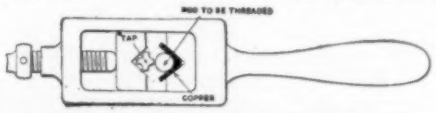
Foot Power Filing Machine

the collar or plunger h strikes the lower side of the upper boss. Another spring k is attached directly to the file frame and has just enough tension to properly balance the weight of the frame so that the latter has no tendency to either drop or lift.

To the lower plunger is secured a strap, reaching to the treadle, which is arranged conveniently for the operator, who sits on a stool in front of the machine. As he depresses the treadle, the lower plunger is pulled down, and with it the frame, so far as the screws will permit; this rocking action brings the file forward into a vertical position and continued downward movement of the treadle causes the lower plunger to descend, sliding through the boss and transmitting, through the medium of the file, the same action to the upper plunger, extending the spring at the same time. Upon releasing the treadle the springs first tilt the file frame, causing the file to recede from the work and then ascend, ready for another stroke.

CUTTING LEFT-HAND THREADS WITH RIGHT-HAND TOOLS.

A correspondent of the American Electrician shows a slight variation of the old scheme of cutting a left-hand thread on a rod by means of a right-hand tap, inasmuch as he shows how to do it with a die-stock, whereas the ordinary plan is to use a vise in combination with a tap and a V-block. The accompanying sketch shows the arrangement. The dies are opened sufficiently to admit a right-hand tap of the desired lead, and the rod to be threaded. The rod is backed up by a piece of annealed copper into which the threads may imbed themselves without injury. The die should be of the same lead as the tap, which permits the tap being accurately meshed with its thread. With this combination it is claimed



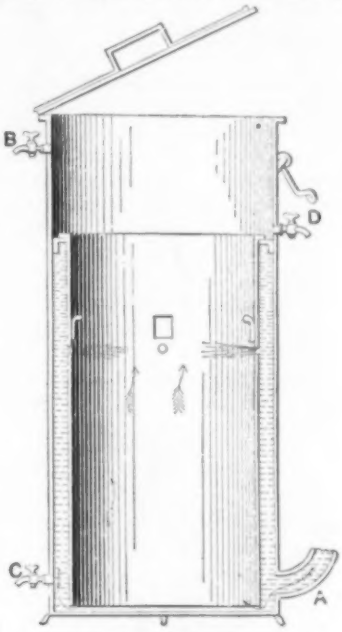
Cutting Left-Hand Thread with Right-Hand Tap

that a fair left-hand thread may be cut with the ordinary right-hand equipment. It now remains for some ingenious reader to show us how a left-hand nut can be cut with extemporized tools.

It costs $10 a week to feed a horse in Pretoria. There is plenty of fertile land but little water.

ABOUT CASE-HARDENING.

Feilden's Magazine, of London, says: It may not be generally known that the case-hardening of iron parts means the partial



Hardening Tank.

conversion of the outer surface into steel. The most common method of case-hardening is to place the pieces in an iron case in company with either bone-ash, leather, or horn cuttings. The high quality and depth of the steel case amply repay for the extra initial cost, taking care that no two pieces are in contact, and carefully luting all the joints between the lid and sides with fireclay or loam, to exclude the air, and heating to redness in a furnace for a time varying with the number and size of the pieces. Many of the leading locomotive makers in England and America use an oil or gas furnace, and they claim several advantages for them over the ordinary type; the temperature can be regulated to a greater nicety, it is cleanly in use, and more economical than the coke or coal furnace.

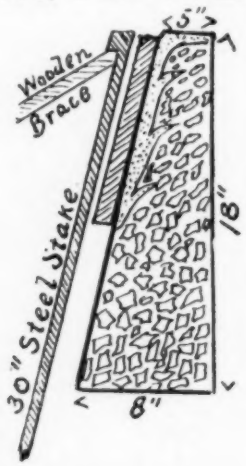
Bone-ash is the cheapest, as it can be used over and over again by adding new bone to the mass and mixing thoroughly each time a box is charged.

The railway mileage of the United States now exceeds 202,500 miles.

HOW TO MAKE CONCRETE CURBING.

Curbing made of concrete is rapidly taking the place of stone. It is not only much cheaper in first cost, but lasts longer and can be made into any shape required. It is less subject to damage from frost. A writer in Municipal Engineering tells how to lay a concrete curb which has been found very satisfactory. He says: We first made curbing with vertical walls on both sides, but soon found out that a much better curb could be made with less cement by making the side next to the gutter battering and proceeded to do the work in the following manner:

First excavate to the required depth of curb, say eighteen or twenty inches, using the earth on one side as a mold, where conditions will admit of it. If the soil is sandy no provision need be made for drainage. Next we set up a mold two inches thick,



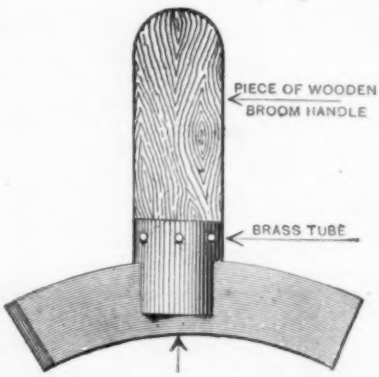
Concrete Curb

twelve inches wide and sixteen feet long, held in place with seven-eighths inch steel stakes, set so as to make a curb eight inches thick at bottom and five inches at the top. Then proceed to fill space with concrete, sliding the mold up as required, until the finish line is reached, then float and trowel on the top and twelve inches down on the face. Cut deep into sections with pointing trowel say three in sixteen feet. Finish front edge to straight edge with quarter-round. Trim edge next to lawn to straight edge, leaving that edge sharp. This makes an ideal curb, looks well, stands well and is well. Note the manner in which the facing is anchored to the backing, as shown in the accompanying sketch. After troweling, brush the work to give it the appearance of sawed stone. We do not consider it necessary to use any metal in constructing curb.

COMMUTATOR CLEANER.

A reader of Power, writing from Australia, describes how he made a very satisfactory commutator cleaner. The device will be new to many of our readers.

The device for cleaning the commutator consists of a piece of wooden broom han-

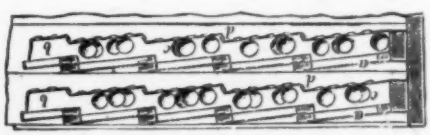


COMMUTATOR CLEANER.

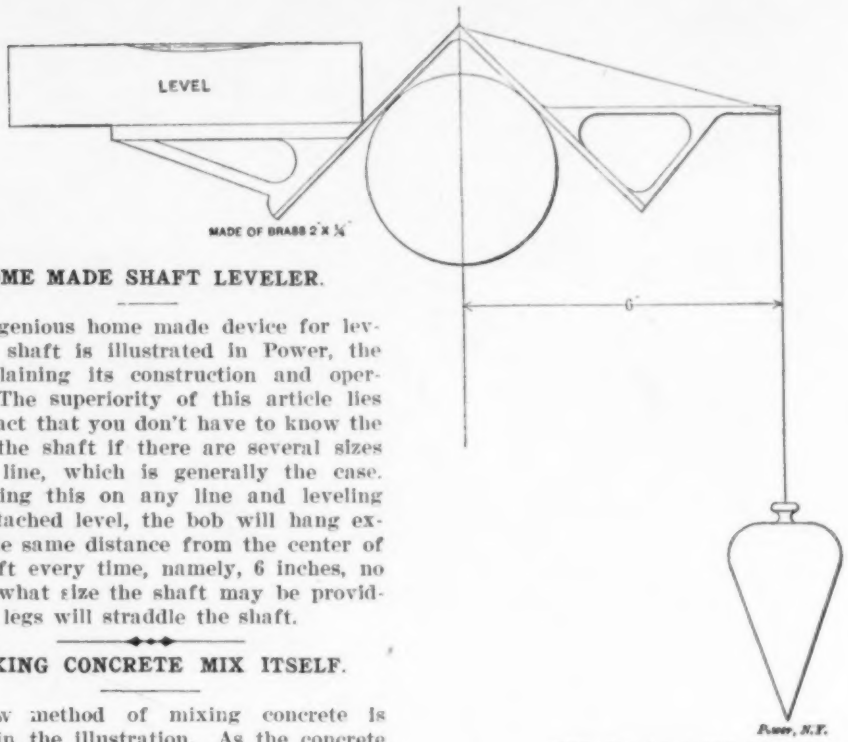
dle with a brass tube to fit it slotted so as to hold a piece of Paragon packing into which is rubbed graphite. With this held against the commutator it cleans it and stops the brushes from chattering and sparking in a great measure.

DEVICE FOR CLEANING SIEVES.

Dr. H. Sellnick, of Leipzig, Germany, well known in the European milling world, has been granted a patent on a device for keeping the meshes of sieves open and free to work, says the American Miller. The



cut shows the plan. Under the sieves, shown at a, are ledges running lengthwise, d, provided with balls or bodies of suitable material, e. When the sieves are in motion the balls are thrown up against the under surface of the sieves and the particles adhering to the bolting cloth or wire are dislodged.



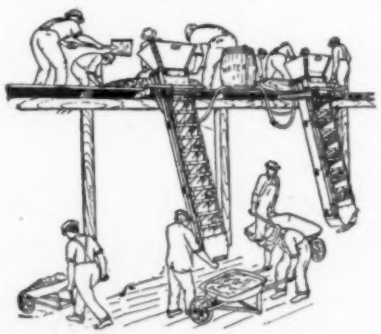
TOOL FOR LEVELING SHAFTING.

HOME MADE SHAFT LEVELER.

An ingenious home made device for leveling a shaft is illustrated in Power, the cut explaining its construction and operation. The superiority of this article lies in the fact that you don't have to know the size of the shaft if there are several sizes on the line, which is generally the case. By placing this on any line and leveling with attached level, the bob will hang exactly the same distance from the center of the shaft every time, namely, 6 inches, no matter what size the shaft may be providing the legs will straddle the shaft.

MAKING CONCRETE MIX ITSELF.

A new method of mixing concrete is shown in the illustration. As the concrete drops from the mixer it falls into buckets fastened to an endless belt. The weight of the concrete as it descends causes the belt to turn the mixer on a platform. Where concrete is to be used in basements,



New Concrete Mixing Method

or other places below the street level, where the cement and crushed stone are dumped, this method works nicely and saves power.

More than 50,000,000 pounds of India rubber, valued at more than $30,000,000, were imported into the United States last year.

TO CEMENT RUBBER TO LEATHER.

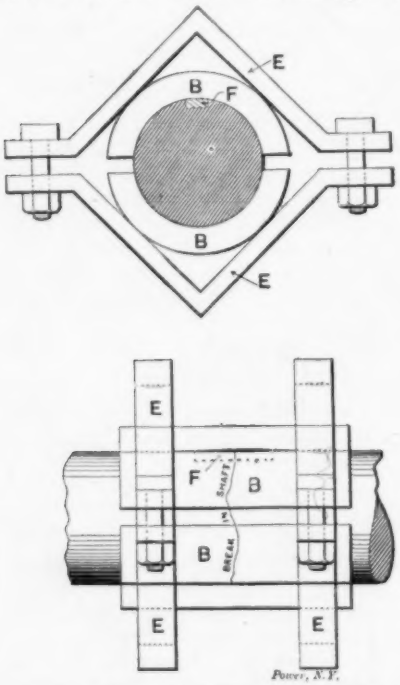
It is sometimes required to cement rubber to leather. The following is a good way, says the American Blacksmith:

Roughen both surfaces with a sharp glass edge, apply on both a diluted solution of gutta percha in carbon disulphide and let the solution soak into the material. Then press upon each surface a skin of gutta percha 1-100 of an inch in thickness, between rolls. Unite the two surfaces in a press that should be warm but not hot. In case a press cannot be used, cut thirty parts of rubber into small pieces and dissolve it in 140 parts of carbon disulphide, the vessel being placed on a water bath of 86 degrees Fahrenheit. Melt ten parts of rubber with fifteen parts of rosin and add 35 parts of oil of turpentine. When the rubber has been completely dissolved, the two liquids may be mixed. The resulting cement must be kept well corked.

The Chicago City Council is being urged to do away with the electric signs on the streets, which have been declared a nuisance.

TEMPORARY REPAIR TO BROKEN SHAFT.

The enclosed sketch shows how I made a quick repair to a broken shaft, says a correspondent of Power, from England. The shaft was used for driving two printing machines and an ink mill. It was owing to the ink mill becoming locked that the shaft was broken. When the manager told



Showing Method of Repairing Broken Shaft

me to look to it I was told to make as quick a repair as possible, as he did not want the printing machines to stand long. I uncoupled the broken shaft so that the rest of the works could run. I then propped the broken ends from the floor, so that I could chip a keyway, as shown by the dotted lines F, about 1½ inches long, ¼ inch deep and ½ inch wide, in both halves, thus making a keyway 3x½x¼. I then filed an old key to fit. When in place I filed it to the same level as the shaft, as shown. I then got a cast-iron bush B, in halves from a very broad pulley. I then borrowed two pair of strong driving clamps E E, such as are used by turners for driving large shafts, etc., when turning. With these I clamped the bushes over the broken part, thus binding the whole together. For a quick repair this will be hard to beat, as the shaft was standing only 1½ hours. I might say that the apprentice was getting the things together and was ready when I had got the keyway chipped and key fitted, or the repair would have taken longer.

A NOVEL METHOD OF PIPE THREADING.

The method of pipe threading referred to is no doubt better "honored in the breach than in the observance;" however, it points a valuable moral, as will be seen.

The reminiscence is related by a one-time superintendent of water service, the incident occurring some twenty-five years ago on a road entering Chicago, says Resourcefulness. Receiving advice that the water pipe was leaking at an important water station, the superintendent of water service went at once to the scene, with such men and tools as he had with him. Arriving at the water station he found the 4-inch wrough-iron water pipe broken squarely off, only 2 feet of water in the tank, and no means of getting a piece of pipe from any shop cut to length and threaded inside of twenty-four hours. Unwilling to interrupt the water supply and determined not to acknowledge defeat until the last resource was tried, he cut a piece of pipe to length with cold chisels, chalked the unthreaded end, placed it in line end to end with a threaded old piece of the same size pipe, and with two-pointed tram, one point engaging in the thread of the old pipe, the other scribing on the chalked end of the blank pipe, he followed the thread with one point, always keeping the train parallel with the axis of the pipe. The path of the right pitch thread was thus scribed by the tram point on the chalked surface of the blank end of pipe requiring thread. The spiral scribe mark thus made was nicked with chisels, deepened and made continuous, until at the end of an hour and a half a good thread was cut, the job put up without a drop of leakage and without the interruption of the water service.

The above incident was modestly related on its own merits as an ingenious little mechanical makeshift, but it is of greater interest as symbolizing that high attribute of generalship which shrinks not in the face of difficulties, but which with skillful use of the means at hand snatches victory from defeat.

The unexplored arctic region, which equals Europe in size, is the largest unexplored area in the world.

DON'T BE AFRAID OF THE DIRT.

Don't be afraid of the dirt, my boy,
That comes from the furnace or file;
Each man who is great
In workshop or state
Has worked in the dirt for awhile.

Take hold of the job with a good strong hand,
Don't think of your skin or shirt;
There's honor sublime
In a hand of grime,
Don't be afraid of the dirt.

You look at the boss in his spotless clothes,
And wish you were clean like he;
But the boss sometime
Has savored of grime,
Or a boss he could hardly be.

There's honor in scars from the battlefield,
Be willing and ever alert;
Don't totter or shirk,
Take hold of the work,
Don't be afraid of the dirt.

—The Draftsman.

GAS TURBINE ENGINE.

The steam turbine, which expert engineers concede will soon displace the present steam engine for many uses, must look to its laurels. Already high expectations are being entertained for the gas turbine engine. Before long some bright mind will doubtless solve the problem. A year ago in our "Hints to Inventors" the suggestion was made of the reward which will accrue to the successful one. Machinery in a recent issue comments as follows:

It is well known that the efficiency of the gas engine depends mainly upon the degree of compression pressure attained in the working fluid. When operating upon the Otto cycle the gas and air are compressed to as great a pressure as practicable, and then are exploded, giving a still higher pressure. This same process can be employed in connection with a gas turbine and has been advocated for that purpose. Under this plan the air and gas would be compressed and exploded in a chamber lined with refractory material, and would then discharge through a diverting nozzle and impinge against the blades of a turbine wheel, as in the case of the De Laval steam turbine. The diverging nozzle would act as an expansion nozzle, to reduce the pressure of the gases to atmospheric pressure and convert their potential energy into kinetic energy before doing work upon the wheel. The discharge would occur in puffs, an impulse being given as often as an explosion occurred.

The General Electric Co. is conducting extensive experiments with gas turbines under the direction of Sanford A. Moss, a gas engine specialist.

PORTABLE ELECTRIC MOTOR.

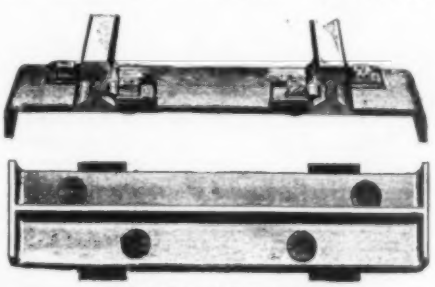
In England and Germany many establishments where electric power is used, are utilizing portable electric motors. These motors are securely mounted on carts by

Electric Motor for Temporary Power

means of which they are taken to any part of the works where temporary power is required. Electric current is secured by long wires which are connected to the feeder wires with which the works are equipped.

STEEL RAILROAD TIE.

The latest type of steel tie to take the place of wooden cross ties on railroads is the invention of O. M. Knox. This tie is 8

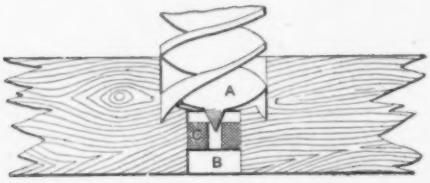


Patented Steel Railroad Tie

feet long, 10 inches wide and ⅝ inch thick. The rail is secured to the tie by four steel clips, fastened by bolts passing through square holes. The ties are cast from open hearth steel.

COUNTERBORING HOLES FOR PATTERN WORK.

"Patternmaker" writes that the following "kink" often comes very handy to him when he finds it necessary to counterbore a hole in a pattern, says Machinery. Under ordinary circumstances the large hole A would naturally be bored first and then in the bottom of this would be drilled the smaller hole B. It is not, however, always practical to do the work in this order, so if the small hole B has been drilled first, and it is then necessary to counterbore the hole A, it is accomplished with the assistance of the small lead disk shown at C. A liberal assortment of different sizes of these



Boring Holes for Pattern

disks is kept in the tool chest and even if one of the exact size is not at hand the softness of the metal readily permits one of a larger size to be shaved down with little trouble. This disk fills the small hole and affords a center for the screw of the drill which is thus led concentric with the hole first drilled. This is a much more satisfactory as well as quicker way of doing this work than the ordinary method of driving a temporary plug in the small hole.

SUGGESTIONS AS TO BELTS.

An interesting article in the National Engineer, on belts, can be summarized as follows: When in the market for leather belting, always buy the best, as it will be found to be the cheapest in the long run. Always use double belts where practicable. Endless belts are preferable to sewed belts. See that the belt is sufficiently wide for the work it has to do. Cut the ends of the belt perfectly square for lacing. Put the grain side of the belt next to the pulley. Do not subject a single belt to a greater tension than 55 pounds per inch of width, nor a double belt to more than 65 pounds; and less would do better in both cases. Do not use resin on a leather belt under any circumstances. If a belt slips under proper tension it shows that it is overloaded, and in such case the speed of the belt should be increased or else a wider belt should be used. Do not employ a "tightener" pulley if it can be avoided. Run a horizontal belt so that the "sag" will be in the upper half. Avoid running a belt vertically, when possible. Use only such belt dressing as will reach the inner fibres of the leather and that will not injure it.

Keep the belt free from dust, oil and dirt. Cover all iron pulleys with leather for best results. In calculating the horse power which a belt will transmit, the smaller pulley only is to be taken into account. Tables giving the horse power of belting are to be found in nearly every work on steam engineering. But the driving power of a belt depends on so many elements, such as diameter of pulley, its material and condition, as well as amount of crown, arc of contact, belt material, width, thickness and tension of belt, that such tables have little or no value.

NEW CAR FERRY FOR ENGLISH CHANNEL.

While engineers are still looking forward to the time when a submarine tunnel will connect England and France, better facilities have been found necessary for immediate demands. Several new and very large car ferries are being built, each of which will carry a train of sleeping cars, or 16 ordinary day coaches. It is also planned to load express trains in southern France with fruit, flowers and vegetables, which will thus be run through to London.

"GREAT BRITAIN AFLOAT."

The "Colonizer," of London says: A scheme is on foot for the organization of a floating industrial exhibit of British manufactures which is to make a tour of the empire. The plan is to fit out a large ship with samples of all classes of manufactured articles which Great Britain supplies or can supply to her colonies. From fifty to one hundred firms are expected to furnish exhibits. The ship will stop at every important port in the British colonies and dependencies, as well as at ports in Japan, China, and other countries to be selected.

ENGLISH BOILER STOKING INDICATOR.

Instrument That Tells Which Fire Needs Fuel

Did you ever have a chance to watch the firemen at work shovelling coal into a large battery of boilers? If so, you noticed how often they opened a furnace door, looked in and shut it again without throwing in any coal. Where one man has only one or two furnaces to feed he can usually carry the time interval of firing in his mind, but where, as in large plants and on shipboard, one man during his watch must keep the steam up to a certain pressure on six or eight boilers, the work then involves more accuracy.

Furnace Firing Regulator

To regulate the intervals of firing, an English inventor named Kilroy has brought out a stoking indicator. It consists of an electric clock which can be set to ring a bell once in every six to ten minutes. How often the bell shall ring is determined by setting the regulator shown in the first illustration, which in the picture is set to sound once in six minutes and forty-five seconds. On shipboard, especially in the navy, the device is expected to prove of great value. In this case the regulator is placed where it can be operated by the chief engineer or assistant, and wires run to the indicator down in the stokehold.

When the alarm sounds, the clock face shown in the second picture shows a figure which is the number of the boiler which needs firing. In this way unnecessary opening of furnace doors is avoided and the regularity of the fuel supply has many advantages also.

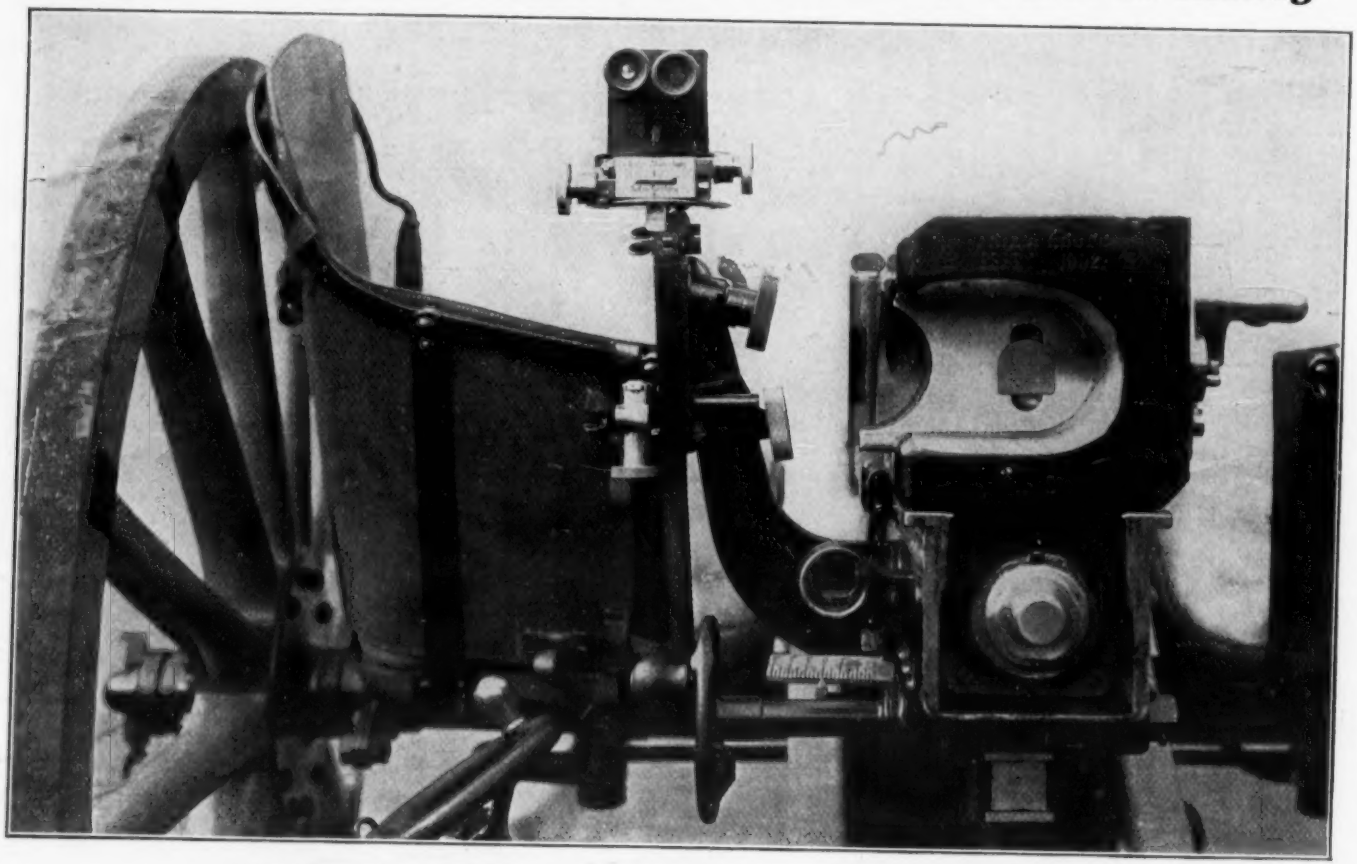
MANY USES OF CHARCOAL.

The Trade Press Review of London says: "Charcoal has many useful properties. Enormous quantities are used for the manufacture of gunpowder and fireworks, it is also used for lining the walls of cold storage warehouses, as it is a bad conductor of heat. For the latter purpose the charcoal from spent dyewood is well adapted and has been largely employed. Great quantities of charcoal are employed as fuel in brajiers and stoves, but principally on the continent, where it is cheap. It has also been largely used for filtering water, owing to its great porosity.

One of the most remarkable properties of charcoal is its power of absorbing gases. A piece of freshly made charcoal will absorb 90 times its own volume of ammonia gas. This is probably the reason why charcoal has been found to act so beneficially on lawns. A sprinkling of small wood charcoal speedily absorbs ammonia, which is nearly always present in air, and forms a condenser for this valuable manure, the grass being greatly enriched thereby.

More than 50,000,000 pounds of India rubber, valued at more than $30,000,000 were imported into the United States last year.

Telescopic Sight that Picks Out the Enemy When in Hiding



Krupp Telescopic Sight on Repeating-Gun Carriage. View from Rear—Courtesy Journal U. S. Attillery.

Makes The Gunner's Aim Unerring

With the Spirit Level Sight, a Krupp Invention, Every Shot May Hit the Target

By Capt. A. E. Plorkowski, of the Imperial German Army

The efficiency of field guns on the battle field depends, to a high degree, on the sighting apparatus. Neither the firing itself nor its rapidity secures success, but it is dependent entirely on its accuracy and the number of hits; for this, correct sighting and laying the guns is accountable.

From a merely technical standpoint, modern guns are precision instruments, their sighting apparatus should be of the same character. Rifled guns for a long time have been capable of an accuracy far superior to that of smooth bores, and have developed into precision arms. Nevertheless they were still provided with the sights inherited from the smooth bores, having only the addition of a lateral movement for drift and deviations.

Besides those errors in aiming which result from poor light, difficult recognition and observation of the target, etc., there are other sources of error in the eye of the gunner himself, and in the possibility of aiming by "full" or "fine sight," instead of "half sight."

All these possible causes for poor aiming are reduced to a minimum, if not entirely eliminated, by attaching a spirit level to the rear sight.

The gun carries the housing (A) of the sight on the upper right hand edge of the breech; the sight stem moves in the housing, and both are curved in an arc, having the point of the front sight as center. The front sight is on the right trunnion. The sight stem and its guides are inclined so that the correction for drift is given automatically at all ranges. Therefore as long as special conditions do not necessitate an extra deviation, no lateral correction is required. In case wind or other conditions make such a correction necessary it is done by turning the milled head as seen in the upper right corner of Fig. 2. Thereby the open sight moves along a scale, divided into 40 parts, each part equivalent to one-thousandth of the length of the line of sight, which is one meter (39.37 inches). The middle of the scale at part 20 indicates the normal. When the elevation is given on the sight stem the level will move with it and when the breech of the gun has been raised or lowered according to the required elevation, the bubble will center.

As soon as the position angle has been determined by the first direct aiming at the target, and eliminated by setting the level, it is only necessary for all subsequent aiming at the same target, to give the gun that elevation at which the bubble is centered.

The position of the level of one gun can at once be taken up by all other guns standing at the same height and firing at the same target. This makes the control of the elevation of all guns in a battery easy. Differences in the position of level which the chief of piece can see from his place

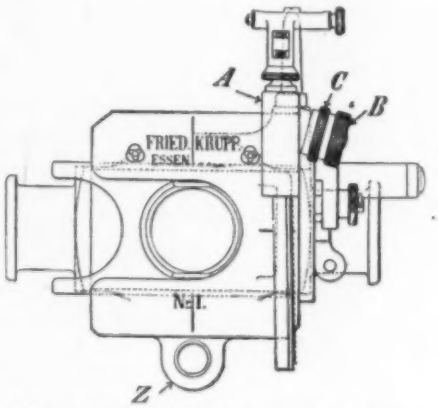


Fig. 1 Rear sight with level. On breech. View from rear.

even during rapid firing, will point out all errors to him.

This easy and reliable control of aiming is especially important when the target is not distinctly visible; aiming then is difficult as also towards covered positions, and this method of control will be the rule in the future. The simple use of the sight with level facilitates the instruction of gunners. The sight with level takes the place of the quadrant in indirect aiming or at night.

Progressing improvement of fire arms has increased their range and effect of projectiles. This leads to covered positions being taken as a necessity. Aiming at covered targets became more difficult with the

use of smokeless powder, because lacking observation of the enemy's fire, it became difficult to discover his position and keep it in sight. On the other hand the advantages of a rear sight with level depend on a first accurate aiming with the open sights and centering the bubble accordingly. Therefore it is an important development to replace the open sight with a telescope.

The telescope makes observation of the

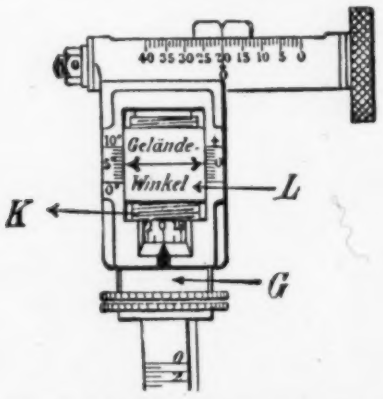


Fig. 2.—Rear Sight with Level—Sight Head—View from Rear.

target easier, and by enlarging, makes aiming more accurate. The optical axis takes the place of the sight line and allows aiming without a front sight; this with gun carriage shields, is an advantage in reducing the necessary opening without limiting the field of view.

Direct aiming at covered positions is often impossible and using an auxiliary line becomes necessary. The old method of obtaining an auxiliary line failed. So an azimuth disc was added to the telescope, dispensing with artificial auxiliary lines. A telescope with its azimuth disc is similar in design, excepting the sight head, to a sight with level attached to the side of the stem.

A short prismatic telescope with cross lines is used. The latter form a St. Andrew's cross with vertical lines above and below for very high or very low auxiliary lines. At night the cross lines can be lighted up by a lantern from the side, and made distinctly visible.

As the stem is inclined for drift, the telescope moves, as the range is given, through an angle corresponding to the drift.

For a quick perception of the target, a "finder" is combined with the telescope in the same housing. The "finder" has an optical arrangement by which the cross lines which are transparent in opaque glass plate, are reflected into the gunner's eye. In looking at a distant target the cross lines appear as if at the same distance.

This apparent coincidence of the cross lines and the real target—different from the appearance in a telescope where the cross lines coincide with the image of the target—makes an accurate, quick and easy aiming at distant targets possible without any focussing. No substantial cross lines could be used, because there are no lenses, and cross lines without a point of sight in front give no line of sight.

At night, the cross lines are lighted up by an artificial light and the polished interior surface of the protecting cover acts as a concave mirror. A recent design allows the optical axis of the telescope to move while the eye piece remains stationary; in this way the gunner can take aim in any lateral direction without changing his place.

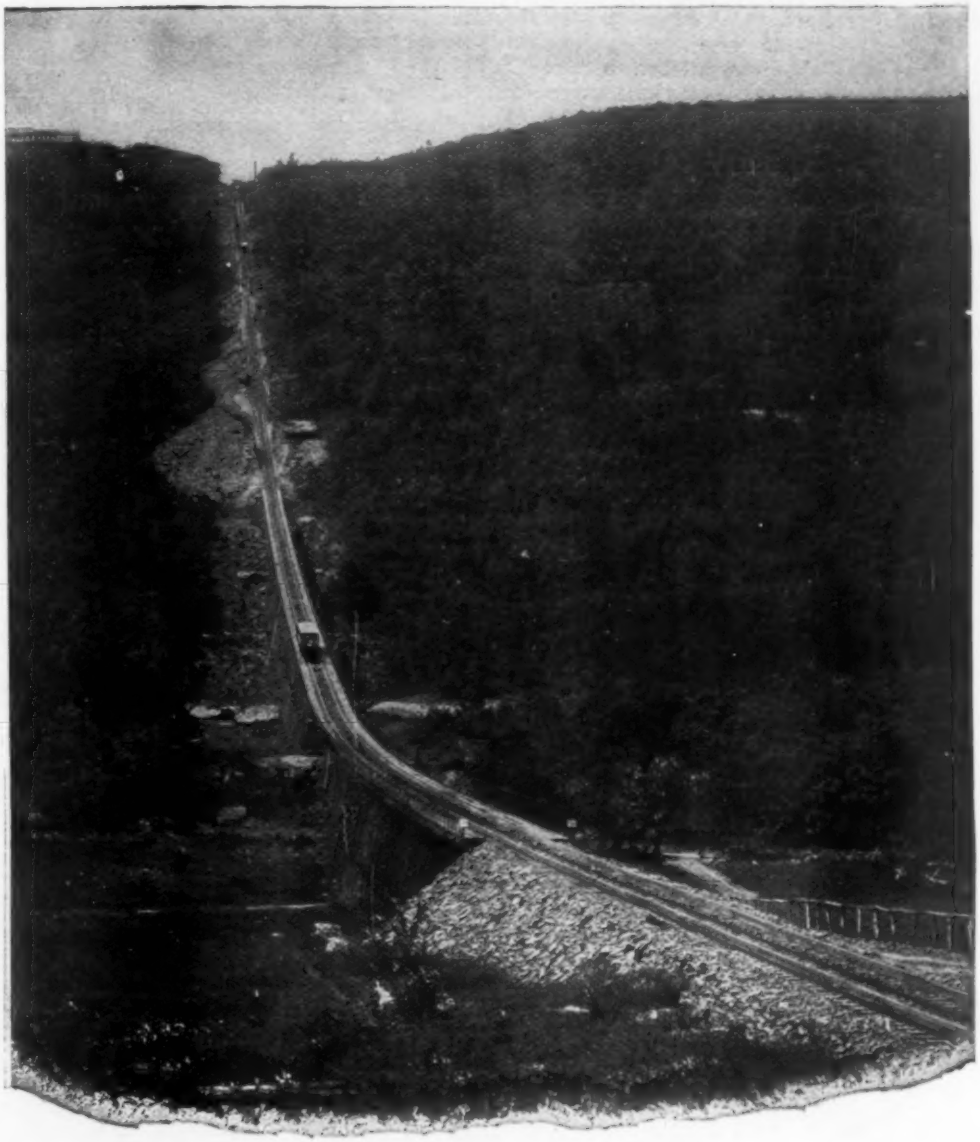
Krupp's experiments with telescopic sights date from 1894. The main difficulties arose from the task to maintain the correct position of the optical axis in spite of the vibrations caused by firing and transporting the gun. Success in this direction was only reached when the terrestrial telescope was replaced by a Porro prismatic telescope; this is so short that it is supported for its whole length on the sight head.

Many such telescopic sights have been made since in Krupp's workshops, as their advantages were readily acknowledged.

Although admitting that its construction is more complex than that of older rear-sights, it undoubtedly works very much better and enables the entire efficiency of the gun to be secured; this was not the case formerly—adding a new instance to the old experience that, where human dexterity fails to fulfill requirements as to the effect of fire arms, mechanical means must come to the rescue and man must compromise with their complications in order to reach his ends.

For a Christmas Present, why not give your friend, or your brother, or your father, or your son a year's subscription to Popular Mechanics. He will appreciate the original gift and twelve times in the year it will serve to remind him of your consideration. See coupon elsewhere.

Road that Climbs the Catskills



The Catskill Incline road probably carries more passengers than any other similar line in existence. Stretched along the mountain's side one and one-half miles, this line in that short distance rises 1,630 feet with a maximum grade of 40 per cent.

The road is the three-rail system with a double-track turnout at the central point, enabling the running of trains in opposite directions. The carrying capacity is 100 people, including baggage, at a speed of eight miles per hour. The power employed is steam. Two Corliss engines are located at the upper terminal of the railway, connected to the cars by heavy lifting cables.

CLEAN DISHES WITHOUT WASHING.

The bugbear of washing dishes in camp is done away with through the invention of Henry Rogers. The device consists of an aluminum plate, of the ordinary form such as is used in every kitchen, with paper forms fitted to lie in the interior. The paper is padded in blocks, so that twenty plates make a pile a quarter of an inch thick, and the plates are so fitted as to cling tightly to the aluminum form and torn off one at a time as soon as the use of each plate is exhausted. This gives the user a

A Clean Dish Without Washing

clean plate at any time, without regard to the hour, the amount of soap, hot water, or firewood on hand. The paper is sufficiently firm to retain its shape for a reasonable period, even though not resting upon the supporting aluminum form, and should one desire to use a dish already in use the paper layer can be lifted out and set aside, leaving a clean plate.

HOW TO MAKE ARTIFICIAL MARBLE.

A new process for making imitations of statuary marble, onyx and other multi-colored stones has been devised in Europe. About 1,000 parts of alum to form 10 to 100 parts of heavy spar (barium sulphate) and 100 parts of water are mixed with the requisite pigments, and the liquid mass is boiled down and cast in a mold. The amount of heavy spar used varies with the degree of translucence desired. After molding it can be polished.

FORGED CAR WHEEL.

A process for making a one-piece steel car wheel has been devised by a Pittsburg inventor. For a 33-inch wheel he uses an ingot about 16 inches in diameter and with steam hammer and hydraulic press forges the ingot until the hub and web are brought practically to the finished size. It is then subjected to a process of heat treatment so that the outer portion of the wheel is brought to a rolling heat, while the web and hub are kept at lower red heat. The rolling process brings the wheel to its final shape.

BOOKS OF THE MONTH REVIEWED.

RADIUM AND OTHER RADIO-ACTIVE SUBSTANCES. Radium, that mysterious wonder of the twentieth century, which threatens to revolutionize science and offers no end of opportunities for scientific speculation, is for the first time made the subject of a book. The work, which in a most thorough treatise on the newly discovered force, is written by William J. Hammer and published by the D. Van Nostrand Company, 23 Murray street, New York. It is entitled "Radium and Other Radio-Active Substances." All the powers yet discovered by the wonderful substances are fully related. The author gives interesting experiments made by himself, and he tells of discoveries of ores of radium and thorium in a mine in Llano county, Texas. He writes of the wonderful experiments made by Prof. and Mme. Currie of Paris, discoverers of the substance. Being the only volume published on these subjects, the work is sure to meet with a hearty welcome by all who are interested in science.

AMERICAN SCHOOL OF CORRESPONDENCE.—Education by correspondence, now becoming so popular among all classes who have not the facilities or means of taking regular college courses, will be found very fully explained in a new catalogue just issued by the American School of Correspondence, at Armour Institute of Technology, Chicago. The list of instructors mentioned therein includes many of the leading technical educators of America. There is a lengthy list of graduates of the school, many of whom now hold very lucrative and important positions, due solely to the instructions they obtained through this most thorough and illustrious institution. The volume contains a map showing the distribution of foreign students of the American school. Some reside within a few miles of the Arctic circle; others are in the Fiji islands; there are students in the Falkland islands, off Cape Horn, and in fact nearly every part of the world is represented in the great army of students that patronize this cosmopolitan school. In New Zealand alone more than 300 persons are taking the correspondence instructions. An arrangement has been made by which a copy of the catalogue will be sent free of charge to all who write to the American School of Correspondence, at Armour Institute of Technology, Chicago, and mention Popular Mechanics.

BOOKLET FOR DRAFTSMEN.—An interesting booklet on drawing and drawing instruments has been issued by the Indianapolis Blue Print Co., of Indianapolis, Ind. The instructions and tables on a hundred subjects contained therein are of inestimable value to all draftsmen and engineers. The booklet is profusely illustrated, making it easily comprehended and handy for reference.

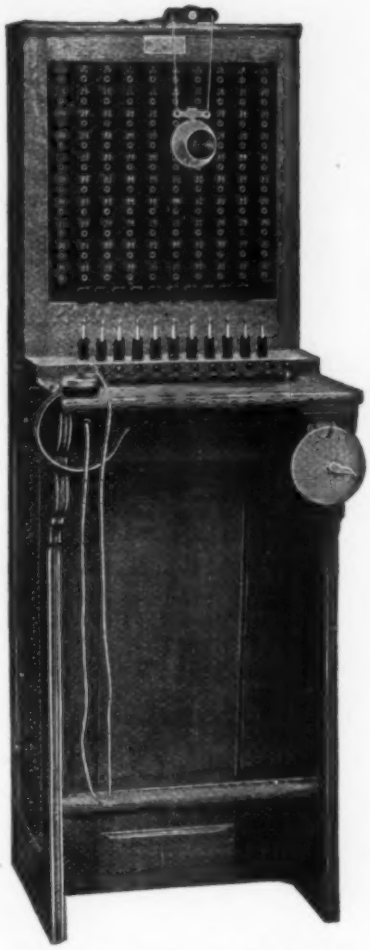
Making and Using of Telephones

How the Tubular Drop Switchboard Works--How to Connect Telephones in Series

In this day of the busy American public, when words are being hurried over wires every minute of the day and night, between houses and between cities and towns, there are few people in the United States who are not familiar with the use of the telephone. Now there is scarcely a village so small that it does not boast of a telephone, scarcely a person so benighted that he does not know how to employ electricity to convey his works afar. Yet with the telephone figuring so intimately in the affairs of our lives there is but a small percentage of our population that ever saw inside a place where telephones are made, or that have an idea how the telephone operator at the central office makes the connection with the different persons desiring to talk with each other.

The tubular drop switchboard is used in most of the central offices for the purpose of making the connections. In using this the subscriber sends in his call by turning an enunciator shutter, sitting immediately above its corresponding jack. The operator upon observing this call for attention picks up an unused plug and places it into the calling subscriber's line jack. The act of placing the plug into the line jack restores the line signal drop to its normal or "no call" position. The operator then draws the listening key into its listening position and makes the usual inquiry. Connections are made in the usual manner.

If no power generator is used the operator will be obliged to use the hand generator during the time the ringing key is being pressed into the calling position. To signal the calling subscriber the push button is pressed. This separates the answering and calling circuits. When subscribers wish to dissolve the connection they turn the magneto generator which sends a current through the clearing out drop and gives the signal to disconnect. The clearing out drop is bridged across the cord circuit and it may be wound to any desired resistance, usually not higher than 650 ohms. Listening and ringing signal may be sent over the calling cord. There may be exclusion of the answering cord circuit and vice versa. A signal may be sent out over the answering cord without disturbing the circuit connected to the calling cord. The operator may listen on the circuit without disturbing connected parties.



100 Drop Tubular Express Switch Board.

HOW TO CONNECT TELEPHONES IN SERIES.

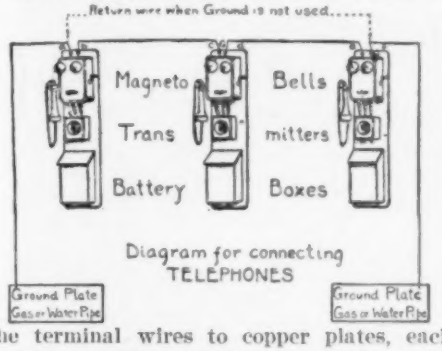
The following directions for connecting telephones in series may be of interest:

If only two instruments are to be connected, one wire should run from binding post marked b, page 367, to binding post c, but if more than two are to be connected, they should be wired as per diagram; b to c, d to e, etc. If the terminal instruments are not far apart, the return wire may be

Where Telephones are Made

Assembly Room—Farr Telephone and Construction Supply Company

run a and f (as per the dotted line), otherwise ground connection must be made from a and f. If they are to be grounded on gas or water pipe, wrap about two feet of bare wire tightly around the entrance pipe, and solder it well to insure a good connection. If this is not practicable, solder the ends of



the terminal wires to copper plates, each having a surface of three square feet, and place them three or four feet into damp earth.

For protection against lightning in all instruments, except terminal ones using a ground wire, run a wire from the center binding post "G" to ground, and insert plug in hole between the metal plates during a storm, taking care to remove same afterwards. In terminal instruments, where a wire already runs to the ground, inserting the plug is all that is necessary.

NEW VARIABLE SPEED MOTOR.

Thousands of users of small power electric motors have long wished for such a machine as the Thompson Electric Works, Chicago, has just put on the market. It is a motor with seven speeds giving a variation of 60 per cent between high and low speed, and this is accomplished without any lowering of voltage. The change of speed is in the field winding of the machine and does away with the speed regulator heretofore necessary, and which so frequently burns out. Moreover nearly the same horse power is secured on the low speed as on the high. The machine is iron clad, very simple and has but three parts.

Mr. Yerkes says: "English men of business don't know the value of the scrap heap; this is the one reason why they have of late years fallen behind in the race for commercial supremacy."

WIDE FIELD FOR LARGE GAS ENGINES.

Internal combustion engines are coming prominently into notice and are certain to be formidable rivals to steam turbines for large power stations. From a thermo-dynamic standpoint they are superior. The conversion of coal into "producer" gas is opening a wide field for gas engines of large size. A producer plant is less expensive to install than a steam boiler plant of equal capacity, and it is vastly more economical to maintain. Where blast furnace gas is available for power production through the gas engine, the advantage economically is enormous. This gas, which heretofore was almost entirely wasted, is now being turned to profitable account. The manufacture of large engines in Belgium and Germany is becoming an important industry.

The internal combustion engine is still in the stage of adolescence, for in the form of the Diesel engine there are wonderful possibilities. It is well known that petroleum affords an excellent fuel for combustion in the cylinder of the gas engine. But it is so highly hydrogenous and its vapor so readily ignited by the heat of compression that only moderate compression can be used with safety. Mr. Diesel has conquered this difficulty effectively. He does not compress the explosive mixture. He compresses air alone, even to the extent of 500 pounds per square inch. At this pressure the air is so hot that a small injection of petroleum is at once ignited; and by combustion the gas formed expands to a great extent. This refers to the action of liquid fuel, but there is no reason why any gas, however rich in hydrogen, may not be used in this manner. It is perfectly safe, for there can be no premature ignition, and it does not explode, but simply burns quietly, exerting its energy most effectively. The Diesel engine seems to offer all the advantages of the steam engine, while it is far in advance of it in economy of working.

BORE HOLES IN IRON WITH OXYGEN.

The well-known combustion-supporting properties of oxygen are turned to advantage in a new German process for perforating thick iron plates. The part in question is heated to incandescence by an oxy-hydrogen blowpipe, and then subjected to the full action of a jet of pure oxygen. A hole of a determined size is bored within four minutes through a 12-inch iron plate.

Great Train of Steel Cars Loaded with Coke

Freight and passenger trains, all of steel, will soon be universal on every important railroad in the United States. Pictures of different kinds of trains of steel cars have appeared from time to time in Popular Mechanics, showing the wonderful popularity they are attaining. In wrecks, as has been illustrated, the steel cars have never yet been injured, while wooden cars in the wrecked train were torn to splinters. The steel cars, being of much larger capacity, are more economical in carrying freight. The accompanying illustration shows a train of steel slatted cars made by the Pressed Steel Car Co., carrying coke on the C. L. S. & E. railroad. Trains of steel coal cars, general freight cars and steel passenger cars have been previously illustrated in Popular Mechanics.

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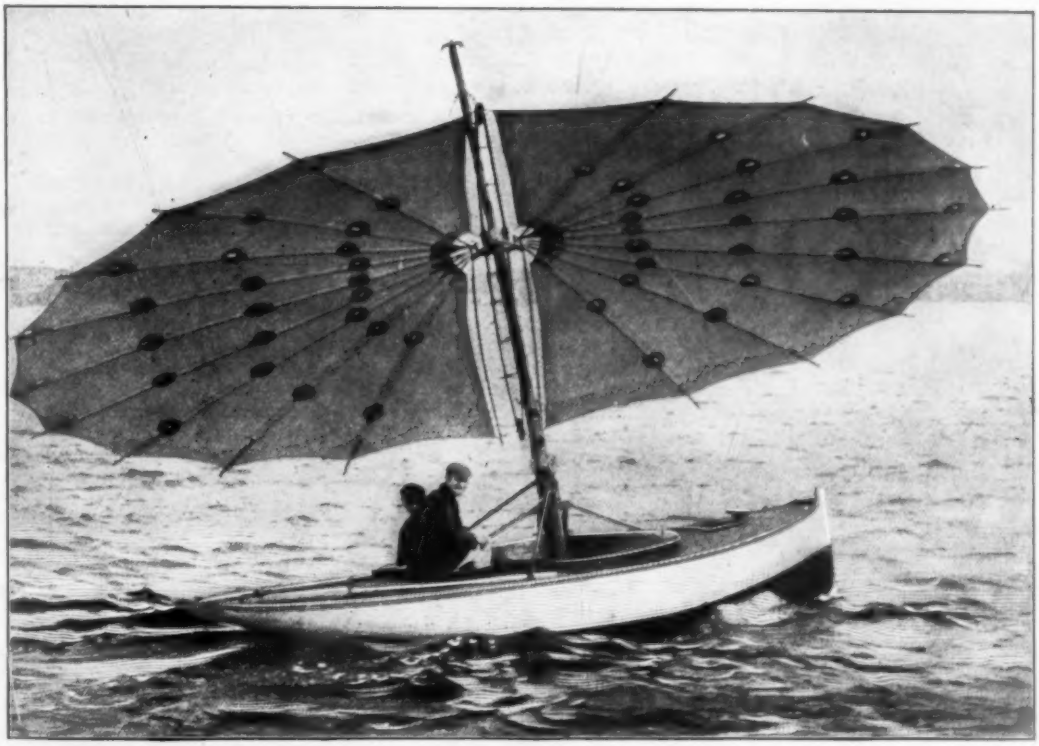

With the Speed of the Wind it Pulls the Small Boat Through the Water in Absolute Safety.---See Page 324.

Popular Mechanics Co., Chicago.

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MR. H. GIGSTAD, Stilson. 85 acres --- netted first year	3,693.77
MR. J. W. LEECH, from Hennepin, Ill., 160 acres --- netted him first year.	6,500.00

INVESTORS: As will be seen this is the mecca for shrewd investors. The men who have made big money on real estate in the past are good men to follow in the present and they are the men who are buying Texas rice lands. Louisiana rice lands have trebled in value in the last five years and it is the opinion of conservative land men that the rice lands of Texas will see an even greater advance in the next five years.

Lands that you can now buy for from $8.00 to $15.00 per acre and that net their owners somewhere between $15.00 and $50.00 per acre per year for every acre put in cultivation are not going to remain at the present low price very long.

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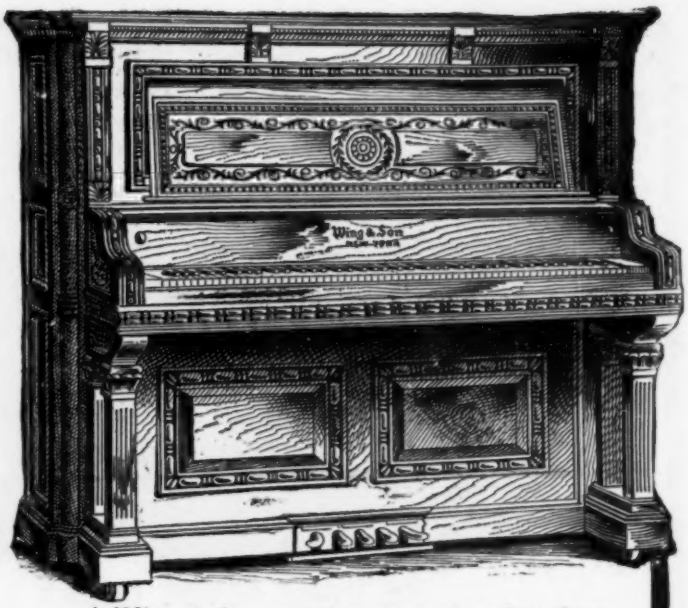

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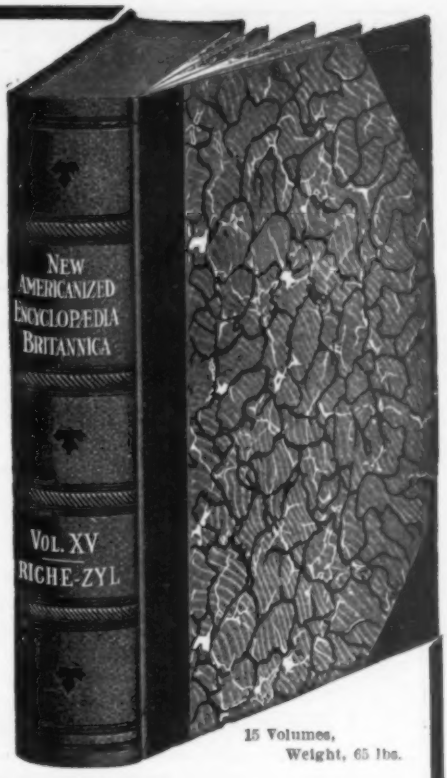

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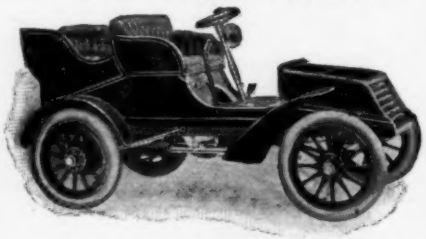

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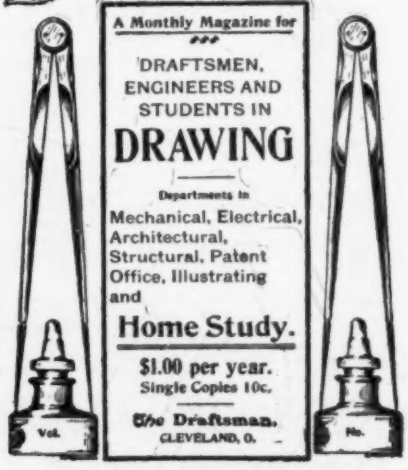

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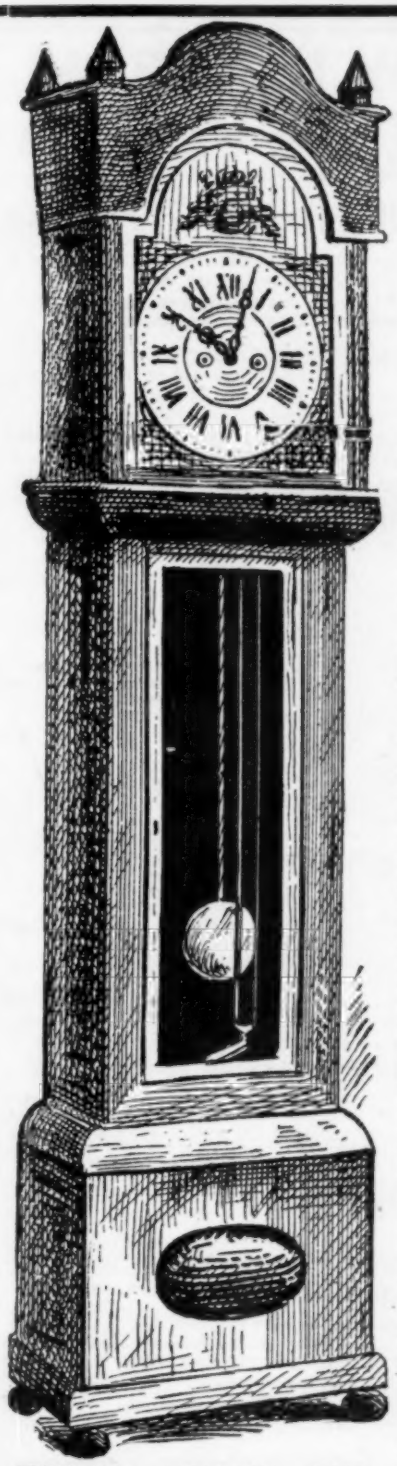

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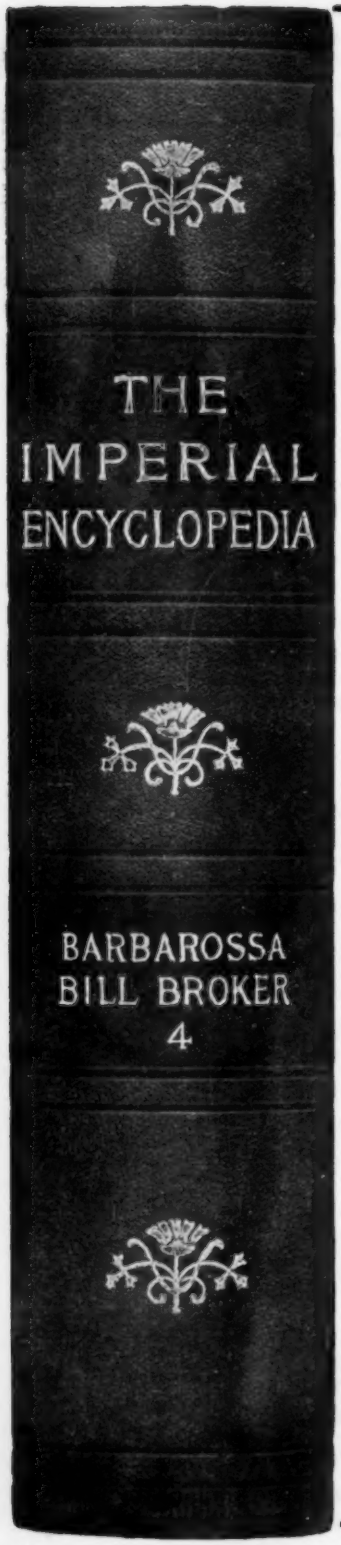

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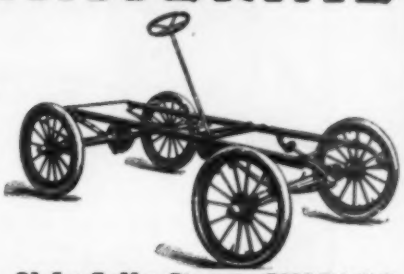

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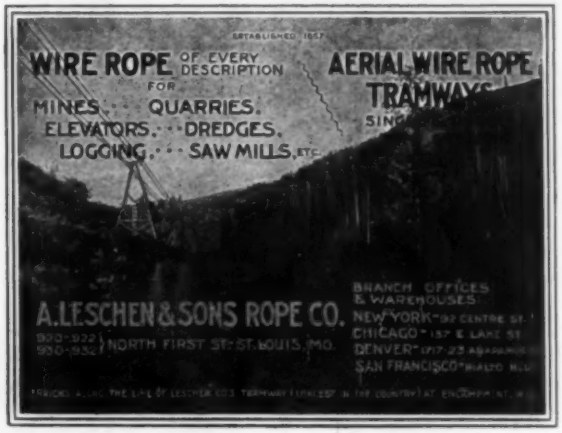
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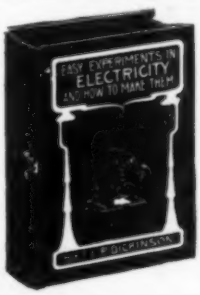

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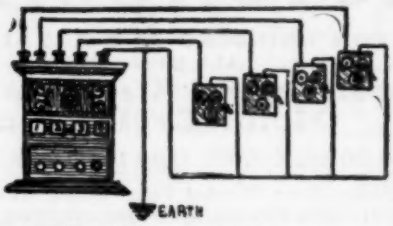

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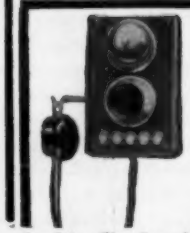

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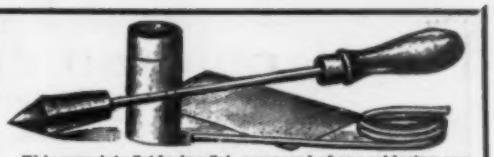

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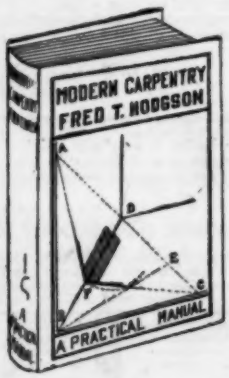

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